JOURNAL

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JOURNAL
OF THE INSTITUTION OF ELECTRICAL ENGINEERS
VOLUME 2 (NEW SERIES) NUMBER 19 JULY 1956

A TOOL OF THE TRADE

SECTION 80 OF THE ANNUAL REPORT OF THE Institution, which appears elsewhere in this issue, gives a few statistics of current activity in The Institution's Library. Most members probably realize that their Library contains the finest collection of books, periodicals and pamphlets touching on electrical science and its applications that exists in Britain to-day. But unless from time to time they find themselves inside the Library on occasions other than the receptions that must perforce be held there, they may not appreciate the full compass of the service it gives, although they can well make use of a part of this through the post. Certain it is that scientific and technical libraries to-day are no longer regarded as repositories of books, where in an atmosphere of tranquillity those with the leisure to do so may browse or study, often mainly for interest and in subjects apart from their day-to-day work. To-day such libraries have a sense of urgency. They are indeed important as sources of scientific and technical information to provide the blood-stream of British technical development, now so essential to the future well-being of these islands. The country must have good specialized libraries. Moreover, such libraries realize this. Very few to-day confine themselves to the provision of books and periodicals—for example, nearly all libraries, including of course The Institution's, provide an information service, seeking to give answers to many questions that reach them by letter or telephone from their clientele. To members of The Institution then, their Library is important, not only as a source of pleasure and interest, but as a very tool of the trade.

Here, therefore, we shall survey the functions of the Library a little deeper than the Annual Report permits. Let it first be said that these are not immutable, and that the Library Committee of the Council and the Librarian are constantly reviewing and seeking to improve the service given.

The collection of recent electrical literature is indeed rich, comprising nearly 10000 books, and sets of over 600 technical periodicals. There is a library in itself of reports, proceedings of meetings and conferences, pamphlets, reprints and specifications, which is separately indexed. This assembly is augmented annually by approximately 1000 pamphlets and 300 books, and a year's issues of some 500 periodicals.

Historical aspects of electrical engineering are also adequately covered by two special collections: the Sir Francis Ronalds Library and the Silvanus P. Thompson Library. Amongst the most famous of their kind in the world, both collections contain 14th- and 15th-century manuscripts, very early books on the magnet, letters by many early experimenters and a precious collection of Faraday manuscripts. There is also the small but interesting Behrend collection, consisting of books once owned by Oliver Heaviside and manuscript notes connected with his mathematical work. In addition many periodicals are in complete runs extending over 50 years, for the Library was established in 1872 shortly after The Institution was born.

It has always been the Council's policy to regard this assembly as a Reference Library where members may freely consult any work listed in the catalogues. However, appreciating the needs of those unable to visit the Institution building, the Council many years ago established a Lending Library, and to this is added a fair proportion of the new books, both English and foreign, that are continually flowing onto the shelves of the Reference Library.

A new edition of the Lending Library catalogue is now available. It lists over 3200 books, including those added up to the end of 1955. This catalogue, priced at 2s. 6d., together with the accessions list published each month in the *Journal*, helps to keep members abreast of the Library's contents. The Reference and Lending Libraries are both classified and catalogued according to the Universal Decimal Classification, a system particularly suitable for scientific and technical subjects. It is, of course, used also for *Science Abstracts*.

In the rapidly developing fields with which members are concerned, the most recent information is usually to

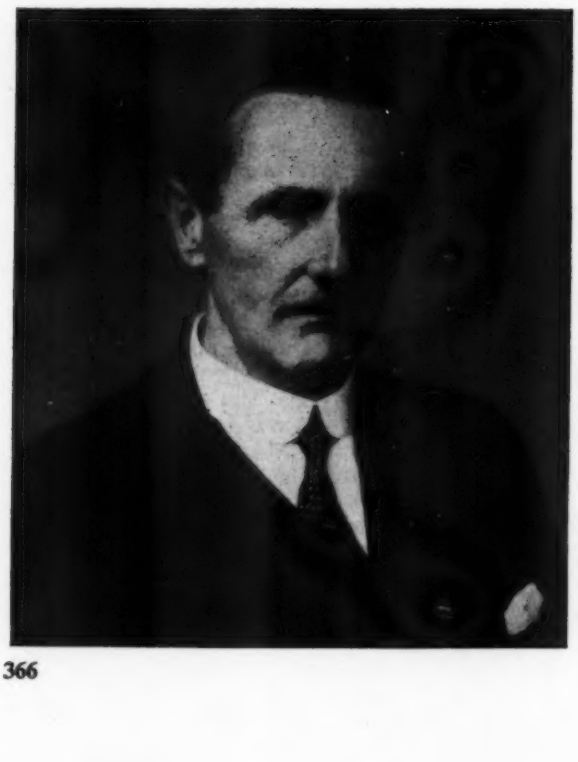
be found not in books, but in the published proceedings of learned societies and in technical periodicals. To know where and when information on a specialized subject has appeared is often a problem for members; it is certain that, to-day, no fully employed engineer can hope unaided to scrutinize, let alone read, all the periodicals covering a specialized field, and thus abstracting services have been set up to deal systematically with the wealth of specialized literature that continually pours out from the all too numerous sources.

The periodicals regularly covered by *Science Abstracts Section B* (Electrical Engineering), are all filed in the Library, the abstracts acting as a key to their contents. Whilst these periodicals may not be taken away, the arrangements made by the Science Museum Library at South Kensington for lending periodicals, or for supplying photocopies of the articles in them, are much used for members by the Librarian. A limited amount of photocopying in the Institution building itself provides an extension of this service to members.

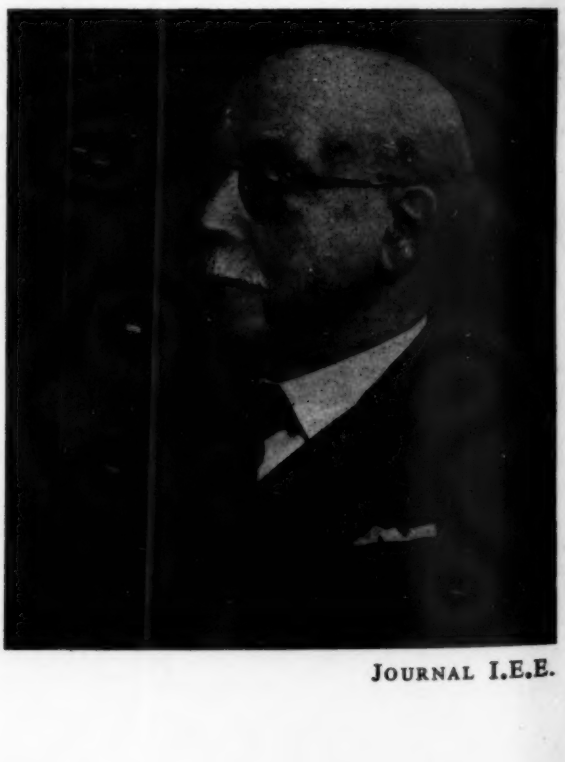
The Librarian and his staff have gradually built up, and are maintaining, a card index of over 50000 abstracts published in *Science Abstracts Section B* from 1947 onwards. This comprehensive index of abstracts is a unique advance in the work of correlating electrical engineering information. Filed in accordance with the Universal Decimal Classification, the cards allow published material on any particular facet of electrical engineering to be readily tracked; they are useful not only to readers but also to the staff in meeting the requests received daily for specialized literature.

In this swiftly developing technological age in which we find ourselves, complacency in any engineering pursuit is likely to be dangerous. The paucity of complaints from members does not necessarily imply that all are content with what they find in their Library. It may not be inappropriate therefore to end this short survey on a questioning note, and with an invitation to members to make their wishes known. One debatable point is coverage. How widely should the Library reap outside the harvest field of electrical literature? Do members come to Savoy Place expecting to be able to consult, in passing, a standard reference book such as *Whitaker* or *The Times Atlas*, or are they surprised to find such books awaiting them? Would they hope to be able to refer if necessary to a reference book on chemical engineering while engaged in research on nuclear energy that was primarily electrical? This kind of question is fraught with considerations of funds and space available for open-access shelves. Even if it were desirable, there can be little increase in the latter at present; moreover an extensive list of scientific and technical books is available to members on order through Lewis's Library, to which The Institution subscribes. But the point at issue is typical of minor aspects of the Library's service on which members' views will be most welcome.

Sir Stanley Angwin, *Honorary Member*



Professor G. W. O. Howe, *Faraday Medallist*



THE KELVIN LECTURE MEETING

Presentations to a new Honorary Member and the 1956 Faraday Medallist

THE FORTY-SEVENTH KELVIN LECTURE, ON 'Radio Astronomy', was given this year on the 26th April by **Professor A. C. B. Lovell, O.B.E., Ph.D., F.R.S.**, at an Ordinary Meeting of The Institution, when the President was in the chair. The Lecture Theatre was nearly full with members and guests, and the audience undoubtedly enjoyed the erudite and stimulating address by Professor Lovell, who is Professor of Radio Astronomy in the University of Manchester and Director of the Jodrell Bank Experimental Station, Cheshire, where a vast new radio telescope is nearing completion under his direction.

Before the Lecture began, the President made presentations of a Certificate of Honorary Membership to **Sir Stanley Angwin, K.B.E., D.S.O., M.C., T.D., D.Sc.(Eng.), Past-President,** and of the Faraday Medal for 1956 to **Professor G. W. O. Howe, D.Sc., LL.D., Member.** In making the first presentation, Sir George Nelson said:

'At the Ordinary Meeting on the 2nd February I announced that the Council had elected Sir Stanley Angwin to Honorary Membership of The Institution. To-night I have the pleasure of presenting to Sir Stanley The Institution's Certificate of Honorary Membership, and I know that this will also please his many friends.

'Sir Stanley has been elected to Honorary Membership in recognition of his outstanding life's work in the field of telecommunication, both national and international, and of his distinguished services to The Institution.

'He was born at Penzance, Cornwall, in 1883, and was educated at East London College, now Queen Mary College. He obtained his practical engineering training with Yarrow and Co., Engineers and Shipbuilders, and in 1906 joined the Post Office Engineering Department. In addition to his duties with the Department in London and Glasgow, he interested himself in the Territorial Force and recruited, almost wholly of Post Office staff, the Lowland Divisional Signal Company. On the outbreak of war in 1914 this unit was mobilized and was formed into the 52nd Divisional Signal Company under Sir Stanley's command. Sir Stanley served in Gallipoli, Egypt, Palestine and France and was awarded the D.S.O. and M.C. He maintained his interest in Territorial work throughout the inter-war period and commanded the 44th Home Counties Divisional Signal Company until 1927. Later he became Deputy Chief Signal Officer to Eastern Command.

'On return to the Post Office after the 1914–18 War he was appointed to the wireless section of the Engineer-in-Chief's office, then rapidly expanding, where his knowledge and experience were applied to the design and construction of high-power radio stations at Cairo, Leafield and Rugby. He was closely connected with the establishment in 1927 of the first transatlantic telephone service and in the subsequent development of short-wave radiotelephone services to all parts of the world—work which made London the world's telephonic centre. After holding a number of senior appointments on the staff of the Engineer-in-Chief, he was appointed Assistant Engineer-in-Chief in 1932. Appointment as Deputy Engineer-in-Chief followed in 1935 and as Engineer-in-Chief in 1939.

'On the outbreak of war in 1939 Sir Stanley was confronted with many difficult problems arising from the dispersal of Government departments and of industries essential to the war effort, and the insistent demands by the Fighting Services for more and more facilities; in addition a large number of Post Office staff had to be released to the Forces. Sir Stanley commanded the confidence and affection of his staff, and evoked from them a response to overcome difficulties.

'Sir Stanley has represented this country at many international telecommunication conferences, where his patience in negotiation has frequently led to his appointment as chairman of committees, particularly those dealing with controversial matters. In 1945 he accompanied Lord Reith on a mission to the sister members of the Commonwealth to discuss changes in Commonwealth communications. This led to the nationalization of Cable and Wireless Ltd., and to the setting up of the Commonwealth Telecommunications Board. After retiring from the Post Office in 1946, Sir Stanley became Chairman of Cable and Wireless Ltd., and in 1951 relinquished this position on appointment as Chairman of the Commonwealth Telecommunications Board, a post which he still holds.

'Sir Stanley was knighted in 1941 and was made a K.B.E. in 1945.

'Keenly interested in education, Sir Stanley has been a member of the Board of Engineering Studies of the University of London for several years, and in 1946 was honoured by being made a Fellow of his old college, Queen Mary College.

'Sir Stanley Angwin joined The Institution in 1910 as an Associate Member and was elected a Member in

1922. He served as Chairman of the Wireless Section in 1931–32, and in 1937 was elected a Member of Council. He became a Vice-President in 1939 and was elected President in 1943. In 1953 he was awarded the Faraday Medal of The Institution for his outstanding contributions to the development of telecommunication in the United Kingdom and international fields.

'It gives me great pleasure, Sir Stanley, to ask you now

Sir Stanley Angwin is congratulated by the President, who holds the Certificate of Honorary Membership

to receive the Certificate of Honorary Membership and to sign the Roll of Honorary Members.'

After receiving the Certificate and signing the Roll, Sir Stanley Angwin replied:

'I am quite overwhelmed at the terms which you, Sir, have used in introducing me. I do look upon this election to Honorary Membership of The Institution as a direct tribute which comes from the Council.

'Honoured as I am, I cannot but feel very self-conscious. I know of no other occasion, except possibly the conferment of an honour at a university, when one has to face such a recital of virtues. On hearing this eulogy I felt like saying to myself "Can it happen to me?" There is a television programme called *This is Your Life*, in which some poor fellow is suddenly presented with all the escapades of his early youth and confronted with people he has long since forgotten. You can see him saying to himself "Can this possibly have happened to me?" Some of the things which you, Sir, have enumerated about me had almost escaped my memory, but I will accept as true anything that has come from you.

'Despite the difficulty of expressing my deep feeling of appreciation at the honour you have bestowed upon me and the pride I feel in receiving this certificate at your hands, Sir, I would thank you for the extremely generous way in which you have referred to my work in the field of electrical engineering during the period of nearly fifty years that I have been a member of The Institution. Throughout my career, including service in the Army and the Civil Service, I seem to have had the good fortune to have been in the right place at the right time, as far as honours are concerned.

'This award comes towards the end of my active career, and I esteem very greatly being placed on the Roll of Honorary Members of The Institution, where I join so many distinguished friends and colleagues. I am particularly gratified that the citation which you have read links the award with service to The Institution, with which I have been so happy to be associated for such a long time. This Institution plays such a great part in the career of those who follow the profession of electrical engineering, that I feel proud of being recognized as having made some contribution to its work.

'Very sincerely I do thank you for the great honour which the Council of The Institution have done me, and you, Mr. President, for the very generous terms in which you have conferred it. It is indeed a red-letter day for me.'

The President next declared that it was now his privilege and honour to present the Faraday Medal for 1956 to Professor G. W. O. Howe. He said:

'At the Ordinary Meeting on the 2nd February I announced that the thirty-fourth award of the Faraday Medal had been made by the Council to Professor Howe.

'The Council decided to make this award of the Faraday Medal in recognition of Professor Howe's pioneering work in the study and analysis of high-frequency oscillations and of the theory of radio propagation; and for his outstanding contributions to engineering education. I am sure that their decision has given widespread pleasure, not only to radio engineers but also to that substantial body of engineers who can count themselves among his students.

'Professor Howe was born on the 4th December, 1875, at Charlton in Kent. He was educated at the Roan School, Greenwich, and, at the age of fourteen was apprenticed at Siemens and Co., Woolwich. He attended evening classes at the Woolwich Polytechnic, and, obtaining the distinctions of a Whitworth Exhibition and a Senior County Scholarship, was able to continue his education at Armstrong College, Newcastle upon Tyne, where he graduated with honours in 1900, and became the senior Whitworth Scholar of that year. There followed two years with Siemens and Halske, Ltd., in Berlin and a short period in that firm's Woolwich branch.

'His teaching career began in 1903, when he was appointed lecturer at Hull Technical College, proceeding to a lectureship at the City and Guilds (Engineering) College in 1905. Four years later he became Assistant Professor, a position he held until 1920, when he was appointed Head of the Department of Electrical Stan-

dards and Measurements at the National Physical Laboratory. The year 1921 saw his return to the educational side of the profession, when he was elected the first James Watt Professor of Electrical Engineering in the University of Glasgow, an appointment he held for 35 years until his retirement in 1946.

'Professor Howe joined The Institution in 1905 as an Associate Member, and was elected a Member in 1910. He took a prominent part in the formation of the Wireless Section in 1919, and in 1921 was elected Chairman of the Section, an office he held for two successive years. He served on the Committee of the Scottish Centre and in 1931 became its Chairman. He was chosen by the Council in 1924 to give the first of the Faraday Lectures, his subject being "World-Wide Radio Telegraphy". His name will also be remembered in connection with the meeting held at The Institution in 1954 in celebration of the Jubilee of the Thermionic Valve, when he spoke on the life and work of Sir Ambrose Fleming.

'Professor Howe's distinguished services to electrical engineering were given in two main roles, namely as an educator and as the author of numerous contributions to electrical science, particularly in the field of radio-telegraphy.

'Many of Professor Howe's papers have been read before The Royal Society, The Institution, The Physical Society and The British Association; others have been published in the periodical scientific Press. All his work is marked by the same appeal to basic principles and the same clear presentation that have distinguished his teaching. His work on the propagation of electromagnetic waves, and the effects of the earth and of the Heaviside layer upon them, led to some of the first calculations of the power required for long-distance transmission. Since 1925 his writings have been concerned more with fundamental concepts of electromagnetism than with radio engineering; they have shed much light in many dark places.

'A further aspect of Professor Howe's work deserves special mention. In 1926 he became Editor of the *Wireless Engineer* and for 28 years, with hardly a break, he wrote a monthly editorial article on some topic of electrical interest. The influence of these articles, which covered all aspects of electrical science, has been very great.'

Professor Lovell delivers his Kelvin Lecture in The Institution's Lecture Theatre

Sir George Nelson then presented the Faraday Medal to Professor Howe, who subsequently signed the Roll of Faraday Medallists. Thanking the President in a witty, reminiscent speech, Professor Howe said:

'I hardly know how to express my appreciation of the honour that The Institution has done me in making this award.

'When one reaches my age one is apt to be rather reminiscent, and as the President said, it is 66 years ago that I began working as an apprentice in the Siemens Works at Woolwich. For five years I worked in the instrument department from 6 a.m. until 5 p.m., and then in the winter I used to hurry home, wash my face, have a meal and go off to the polytechnic two or three times a week to attend evening classes. They were, shall I say, the pre-namby-pamby days. An apprentice was supposed to use his hands all day and then use his brains in the evening. Now, of course, that has changed. He starts at 8 a.m., and you cannot expect him to-day to use his

hands from 8 a.m. until 5 p.m. and then go and use his brains. Whether the modern arrangement is any real improvement I often have my doubts.

'However, after five years at the bench and lathe, the works manager heard what was happening at the Woolwich Polytechnic; he sent for me, and the next week I was in respectable dress turning up at 9 a.m. instead of 6 a.m. I was transferred to the cable department, designing and estimating, and I look back on that with great pleasure. Then, as our President has said, I was awarded the London County Council Senior Scholarship, with which I went to the Durham College of Science, which afterwards became the Armstrong College and is now King's College, Newcastle upon Tyne.

Sir George Nelson presents Professor Howe with the Faraday Medal

'You may ask why I went from Woolwich to Newcastle when in London we had the University College, King's College and the Imperial College, and particularly when there was no electrical engineering department at Newcastle. It was only after I had been there a year that they founded a department of electrical engineering under Dr. Thornton. The explanation is this. I was told to consult the Head of the Education Department of the London County Council as to what I should do with this scholarship, and he virtually told me, together with several others, to go to Newcastle—the reason being that before he was appointed to the London County Council he was the Principal of the college there.

'I look back with very great pleasure to the time I spent at Newcastle, and in 1900 at the end of my three years I obtained a degree and the senior Whitworth Scholarship, with which I was able to go and spend two years in the Siemens Works in Berlin. That was a very wise step. I hesitated for some time whether I should carry on my academic career, but it was Dr. Thornton who advised me that if I could possibly get into a German works such as Siemens I should do so. I have never regretted the decision.

'After coming back to this country I had not been long in the works in Woolwich before I had a feeling that I wanted to teach, and so I went to Hull, where I obtained a post as lecturer at the Hull Municipal Technical College. After two years there I joined the staff at South Kensington, where I spent a very happy fifteen years.

'Sir Joseph Petavel, who was the Director of the National Physical Laboratory, tempted me to go from South Kensington to the National Physical Laboratory. I thought that this was a good thing and I went, but I had not been at the Laboratory for more than two or three months before I began to feel miserable. Everything was done very nicely there, but I felt that I should not be happy until I got back with a class of students in front of me. I told Sir Joseph how I felt and just after that the James Watt Chair was founded at Glasgow. I applied for and obtained the post. Sir Joseph, I remember, hit the table when I told him and said "You are a damn fool". However, I went to Glasgow and I have never regretted that step.

'I thank you, Mr. President, and The Institution, for the great honour you have done me in awarding me the Faraday Medal.'

The 1954–55 Page Prize and Institution Prizes, for Higher National Certificate and Diploma students, were then presented. The Page Prize, which is awarded to the best of those candidates who obtain distinctions in all the compulsory subjects of the final year of the Higher National Certificate in Electrical Engineering, was won by Mr. A. C. Mason.

After these presentations the President called on Professor Lovell to deliver his Kelvin Lecture, saying that Lord Kelvin was for fifty years professor at the university of one of our great industrial centres, Glasgow, and that it was appropriate that the Lecture to-night in his memory should be given by a professor from another great industrial centre, Manchester. Although Professor Lovell was educated at Bristol, much of his work had been done in the North, in the field of radio astronomy.

Professor Lovell then rose to give his Lecture; this was admirably delivered and wholly intelligible to those with only lay knowledge of astronomy. It included some fascinating cosmological speculation, interesting lantern slides—both astronomical and terrestrial—and a demonstration of noise received from a distant star. The text of the Lecture will be published in Part B of the *Proceedings*, and an abstract of it will appear in the *Journal*.

A vote of thanks to Professor Lovell was proposed by Professor E. B. Moullin and seconded by Dr. Willis Jackson.

A minor point of interest about this meeting was that the new Institution tie was being worn for the first time—by the Secretary.

Annual General Meeting of The Institution, 1956

THE PRESIDENT, SIR GEORGE H. NELSON, took the chair at the 84th Annual General Meeting on the 17th May, 1956, at 5.30 p.m. He first announced that only Corporate Members and Associates were entitled to vote at the meeting.

The following list of donors to the Library for the year ended 31st December, 1955, was taken as read, and these donors formally received the thanks of the meeting:

Académie Royale de Belgique; A.C.E.C. Charleroi (Belgium); Edgar Allen & Co. Ltd.; Allis-Chalmers Manufacturing Co. (Milwaukee); Aluminium Development Association; L'Aluminium Française; Aluminium Union Ltd.; Amalgamated Wireless (Australasia) Ltd.; American Institute of Electrical Engineers; American Institute of Physics; American Radio Relay League; American Society of Civil Engineers; American Society of Mechanical Engineers; American Telephone and Telegraph Co.; J. P. Anderson; *Annales de Radio-électricité*; A.S.E.A. Electric Ltd.; G. L. 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Ltd.; Central Board of Irrigation (India); Central Electricity Board, Mauritius; Central Electricity Authority; Central Water and Power Commission (Simla); Chapman and Hall Ltd.; Chief Meteorological Officer, Falkland Islands; Cleaver-Hume Press Ltd.; W. M. Colles; Colonial Development Corporation; Colonial Office; Commonwealth Scientific and Industrial Research Organization; Compagnie Française Thomson-Houston; *Compressed Air Engineering*; Conférence Internationale des Grands Réseaux Électriques; Consiglio Nazionale delle Ricerche (Rome); Copper Development Association; Crompton Parkinson Ltd.; Dansk Ingeniørforening; Department of Government Electrical Undertakings, Ceylon; Department of National Development, Commonwealth of Australia; Department of Scientific and Industrial Research; Derby Society of Engineers; Economic Commission for Europe; Edison Electric Institute; Éditions Berger-Levrault; Éditions Eyrolles (Paris); Éditions Albin Michel (Paris); Eidgenössische Technische Hochschule (Zürich); Electric Railway Society; Electric Supply Authority Engineers' Institute of New Zealand (Inc.); Electrical Association for Women; Electrical Communication Laboratory, Tokyo; Electrical Contractors Association; *The Electrical Manufacturer*; Electrical Power Engineers' Association; *Electrical and Radio Trading*; Electrical Review Publications Ltd.; Électricité de France; Electricity Corporation of Nigeria; Electricity Supply Commission (Johannesburg); Électro-Magazine (Paris); Électromécanique S.A. 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Ltd.; Metropolitan Water, Sewerage and Drainage Board, Sydney; Midland Silicones Ltd.; Ministro da Viação e Obras Publicas (Rio de Janeiro); Ministry of Defence; Ministry of Fuel and Power; Ministry of Transport; *Modern Refrigeration*; Mond Nickel Co. Ltd.; E. W. Moss; E. B. Moullin; The Earl of Mount Edgcumbe; Muirhead and Co. Ltd.; Mullard Ltd.; Multicore Solders Ltd.; Murex Welding Processes Ltd.; Murphy Radio Ltd.; National Electrical Manufacturers' Association; National Industrial Fuel Efficiency Service; National Physical Laboratory; National Register of Electrical Installation Contractors; National Research Council (Washington); National Smoke Abatement Society; Netherlands Physical Society; Netherlands Radar Research Establishment; New Zealand State Hydroelectric Department; George Newnes Ltd.; North of Scotland Hydro-Electric Board; Northern Rhodesia Government; Oerlikon Ltd.; Organisation for European Economic Co-operation; Parkside Press (Dublin); C. A. Parsons and Co. Ltd.; Bruce Peebles and Co. Ltd.; Pergamon Press Ltd.; Philips Electrical Ltd.; N.V. Philips Gloeilampenfabrieken; Physical Society; Sir Isaac Pitman and Sons Ltd.; Polytechnic Weekly Magazine (Amsterdam); Public Transport Association; Purdue University; Radio Corporation of America; Radio Heaters Ltd.; Rand Water Board; J. N. Ratcliffe; J. F. Riley; R.C.A. Photophone Ltd.; A. Reyrolle and Co. Ltd.; John F. Rider Inc.; Royal Electrical and Mechanical Engineers; Royal Institute of British Architects; Royal Institute of Chemistry of Great Britain and Ireland; Royal Institution of Great Britain; Royal Signals Institution; Royal Society of Edinburgh; M. G. Say; Science Museum; T. R. Scott; *Scottish Electrical Engineer*; S.A. des Ateliers de Secheron; J. Sharpe; Short Wave Magazine; Siemens Brothers and Co. Ltd.; Siemens und Halske G.m.b.H. (Vienna); Singapore Improvement Trust; Société d'Électricité de L'Escaut (Belgium); Société Financière de Transport et d'Enterprises Industrielles; Société Générale de Constructions Électriques et Mécaniques; Société des Ingénieurs

Civils de France; Société mixte pour le développement de la technique des télécommunications sur câbles; Society of Power Engineers (Simla); South African Institute of Electrical Engineers; South African Institution of Civil Engineers; South African Institution of Mechanical Engineers; E. and F. N. Spon Ltd.; Springer-Verlag (Vienna); Standard Telephones and Cables Ltd.; S. A. Stigant; Sulzer Brothers (London) Ltd.; Svenska Elverksförening; Svenska Teknologförening; Svenska Vattenkraftförening; Swedish Chamber of Commerce for the United Kingdom; Technical Association of Malaya; Technical Press Ltd.; Technical Publications Ltd. (Wellington); Technion Society of Great Britain; Technitrade Journals Ltd.; Telecommunication Engineering and Manufacturing Association; Telefonaktiebolaget L. M. Ericsson; Telefunken G.m.b.H.; Telephone Engineer Publishing Corporation; Telephone Manufacturing Co.; Television Society; Temple Press Ltd.; T. B. D. Terroni; Textile Institute; Thames and Hudson Ltd.; Timber Development Association; Union Internationale des Producteurs et Distributeurs d'Énergie Électrique; United Kingdom Atomic Energy Authority; Universidad Nacional de Eva Perón; Université de Paris; University of Washington; L. de Verebély; Casa Editrice Dottor Francesco Villardi; Vulcan Boiler and General Insurance Co.; Thomas Wall and Sons Ltd.; T. C. Waters; Welmec Corporation; Western Union Telegraph Co.; Westinghouse Electric International Co.; Henry Wiggin and Co. Ltd.; Wild-Barfield Electric Furnaces Ltd.; G. E. Williams; H. E. Wimperis; M. D. N. Wyatt.

The President then introduced the Annual Report (see p. 377), saying in the course of his remarks:

'The first section deals with membership, where again there is an increase in the number of Members to be recorded, the total now being 40038, of whom over 21000 are Corporate Members and nearly 12000 are Graduates. The number of Students unfortunately continues to fall, but the Council have approved measures which it is expected and hoped will increase the applications for Student Membership. The desirability of a wider use of the title "Chartered Electrical Engineer" has been re-emphasized by the Council.

'The Supplemental Charter which we sought last year has been granted by Her Majesty The Queen, and a note of its main provisions is given in paragraph 10.

'The next section of the Report deals with The Institution's activities, and I am very glad to be able to say that these have been maintained at a high level. The Convention on Digital-Computer Techniques, which is referred to in paragraph 13, was a great success and attracted a record attendance. The Convention on Electrical Equipment for Aircraft was well supported and equally successful.

'Although it is impossible to review in detail the activities of the Local Centres and Oversea Branches and Committees, they have all maintained, and some have indeed exceeded, their previous levels of activity. Unfortunately, however, the Graduate and Student Sections are not being supported as well as the Council would like, but a slight improvement is discernible, due no doubt to the measures to which I have just referred.

'The attendance of His Royal Highness the Duke of Edinburgh at the Annual Dinner of The Institution gave great pleasure to us all.

'Section C of the Report deals with the work of various technical committees. All these are hard-working committees, but I feel that I must refer particularly to the work of the Joint Committee on Model Forms of General Conditions of Contract. The forms of contract which it produces are most valuable. The work of the Committee on Regulations for Electrical Equipment of Buildings also calls for special comment. The 13th Edition of the Wiring Regulations—completely revised—was published in September last and has received most favourable comment.

'Section E deals with the year's work in the field of electrical engineering education and training. This, I need hardly say, is one of the most important activities of The Institution and receives much attention from your Council. The problem of increasing recruitment to the profession is still with us, and is being actively tackled. I am glad to say that the film *The Inquiring Mind* has been extremely successful. It has been shown at over 200 schools and before more than 150 other organizations, apprentices' associations, training officers, and so forth, in all parts of the country. Copies have been sent to Australia, New Zealand, South Africa, Canada, West Africa, and you will be interested to hear that a programme of nine showings has just been completed in East Africa, with the help of our Oversea Representative there, Mr. A. E. Cosgrove.

'Discussions with the Ministry of Education on technological education continued during the year. Touching on the remarks in the Introduction to the Report about the new Council for Technological Awards, your Council are now gratified that the Board of Studies in Engineering have agreed that the award to be given for engineering studies should be known as "Dip.Tech.(Eng.)" to distinguish it from the award to be given for other technologies, which will be simply "Dip.Tech."

'The provision of adequate courses for electrical technicians has received much attention, and, as a result of the conferences on this subject which have been sponsored by your Council, the City and Guilds of London Institute has prepared regulations and syllabuses for the conduct of examinations for electrical technicians.

'In Section F of the Report some information is given about the use which members make of the Library of The Institution and about the increasing number of papers which have been published in the *Proceedings*. To reduce the constantly increasing expenditure on paper and printing, it has been necessary to limit further the length of papers and contributions to discussions. Care will be taken, however, to ensure that none of the essential contents of papers or discussions is lost.

'Many members have taken the trouble to write to the Secretary to say how much they like the *Journal* in its new style. The Papers Committee and the Editor will not be resting on their laurels, and will constantly seek ways and means of increasing the interest and usefulness of this publication. One thing the Editor would like to have is more news from oversea, and any material which members travelling abroad can provide, either by writing an article themselves or by persuading members they meet oversea to do so, will be welcomed.'

Sir George Nelson then moved that the Annual Report of the Council be received and adopted, and after Mr. L. W. Phillips had formally seconded the motion, the Report was thrown open for discussion.

Mr. L. W. Phillips stated that this was the first* Annual General Meeting to which all grades of Members had been invited. He wanted to know why the Council had suddenly made this change.

He was glad that the Council were devoting attention to the decline in Student membership. Last year there had been a resignation of 70 Students and a lapsed membership of 655. Was this because of difficulty in transferring to Graduate or Associate Membership? Again, many joined The Institution at a later stage, and they came in as Associate Members. He thought it far better if people joined as Students because of their interest in the profession from the very beginning, and grew up as members of it.

He was rather bothered about The Institution's intended publication of technical books. That was not its duty. He hoped that the Council were not starting up in competition with commercial publishers. Mr. Phillips asked for more information from the Council.

He would like to see a few social amenities for all members. A member should be able to bring a friend to the Institution building and to have a cup of coffee with him. Many alterations had been made to the Charter, and if necessary they ought to alter the Charter to allow more social amenities for members to be provided.

Mr. Phillips was also very concerned that members did not know each other as they should do. Not technology but comradeship and standing together as a profession made members effective in the world. Such standing together did not depend on the understanding in their heads but the understanding in their hearts. He suggested that the Council should consider local groups for London. There was as great a need for such groups in London as there was for provincial groups, because the people scattered in the different London districts never had an opportunity of meeting together.

The Council seemed absolutely blind (as most members were; they must not blame the Council, but themselves) to what was happening in the world. There was a tremendous revolution—social, economic, industrial, and human—and they, as electrical engineers and physicists, had contributed largely to it. That was going to overwhelm them all unless, besides technological advances, members of The Institution could contribute something towards the humanities. Members must realize that any moral stamina, any contribution towards unselfishness and towards the development of the better side of men, must come from the professional bodies. In the old days the difference between a tradesman and a professional man had been that a tradesman did it for profit and a professional man was ready to give his life in many ways without any concern for money whatever. If they could contribute only something technical, they had failed. It was something of a higher quality that they must engender. They must seek to develop in the candidates that came into their profession not only the desire to think hard and to contribute as much as they could towards technological progress, but also to contribute their utmost towards the salvation of the world, which would come only from the humanities.

Mr. P. G. Ruffhead also asked about the classes of members who are admitted to the Annual General Meeting. Now that the term 'Chartered Electrical Engineer' was to be incorporated in new Diplomas, he wondered whether this could be done retrospectively on existing diplomas. Many members would appreciate such action, because of the general ignorance of the public about the status of the term 'Chartered Electrical Engineer'.

Mr. R. W. Hardisty referred to the Convention on Digital-Computer Techniques, which he considered very successful. However, with the large attendances, the discomfort inside the Lecture Theatre during meetings was something to which attention should urgently be given. The ventilation was really inadequate.

The President then replied briefly to points made by speakers. He said that he fully agreed with Mr. Phillips's comments on the building up of membership from students to fully qualified men. But they were not able to act as in some other countries, i.e. to direct people into certain stages of their technical activities at certain times of their lives. They could only try to attract students at an early stage.

To serve coffee in the Institution building to meet casual needs would be difficult. They tried to give such courtesy as they could to visitors, but it would be very hard to cover odd cases such as Mr. Phillips had in mind without running into expense and difficulty of organization. However, the question would be submitted to the appropriate Committee for consideration.

Speaking on the point raised by Mr. Hardisty, the President assured the meeting that the discomfort in the Theatre was well known to the Council. The whole question of the accommodation of our growing Membership was under consideration, and this particular question would be taken care of in due course.

Sir George Nelson ended with these words: 'With regard to the members' responsibility for technical progress, I am sure that all of us agree with what Mr. Phillips said. We have a responsibility. If I may say so, we are doing a great work throughout the world. We have every reason to be proud of our profession and of what we are doing to help our fellow-men . . .

'I am quite sure that will continue, and I am sure that we are all grateful to Mr. Phillips for the spur that he has given us all in that respect.

'Mr. Ruffhead raised the question of Diplomas. I am not familiar with the details of it, and so I will ask the Secretary to comment on it.'

The Secretary rose to say: 'It would not be possible to alter Diplomas that have already been issued. The Diplomas were issued under seal. The seal, of course, is the signature of The Institution, a corporate body which, under the law, can act as an individual. One cannot modify a sealed document, nor can one issue a duplicate. If a member loses a Diploma, all we can do is issue him with a certified copy, but that certified copy cannot be

* It was in fact the second. The wording of the notice convening the A.G.M. was altered in 1955.—*Editor.*

sealed. I am afraid, therefore, that the legal conditions governing the issue of these Diplomas would make it impossible to endorse those that have already been issued.

'On the point raised by Mr. Ruffhead and by Mr. Phillips, the view was always taken up to 1955 that it was only Corporate Members and Associates (and, by the definition in the Bye-laws, any member of any other class who was serving on the Council at the time), who were entitled to vote at the Annual General Meeting. Successive General Purposes Committees, supported by the Council, have felt that there were two points: first, that it might be embarrassing to have present at the meeting those who could not vote, and secondly, that it might be difficult if a matter came to a division to differentiate quickly between those who were entitled to vote and those who could not. However, in the light of the experience of Annual General Meetings since the war, recent General Purpose Committees have considered that these matters were less important than giving the junior members—Graduates and Students—the opportunity of coming to an Annual General Meeting and hearing the presentation and the discussion of the Report and Accounts. That is the reason for the change in the method of notice, but it still remains the fact that under Bye-law 73 it is only Corporate Members and Associates and Members of Council who can vote during the progress of an Annual General Meeting.'

Dr. R. L. Smith-Rose then replied to points about publications raised by Mr. Phillips. As a member of the Technical Publications Panel he assured Mr. Phillips that there was no intention whatever of adopting any spirit of competition with publishers. What the Panel had been considering was the reprinting of certain classic textbooks which had gone out of print and which, after discussion with the publishers, they understood could not be reprinted economically. They were also considering a new book which had been offered to several publishers, who had all turned it down. The Panel thought that the text ought to be available to students and other workers in the field, and they therefore considered that The Institution had some responsibility for seeing that the book was published.

The motion for the adoption of the Report was then carried unanimously by the meeting.

The President next asked the Honorary Treasurer, Viscount Falmouth, to present the Accounts (see p. 400) for the year ended 31st December, 1955.

In presenting the Accounts to the Meeting, **Lord Falmouth** said: 'May I first draw your attention to the revised layout which has been adopted for The Institution's Accounts and Balance Sheet for 1955, and which I think has a more pleasing appearance. I hope that you will find it easier to read.

'I am sorry to have to report that expenditure in 1955 exceeded income by £4 366, as shown at the foot of the statement of income on page 401. This deficit arises after transferring to the Rebuilding Reserve Fund the amount of the interest on investments, which is, of course, a capital receipt. This is in accordance with the policy laid down by the Council, which has had the support of members.

'Owing to the continuing inflationary spiral, costs have again risen during this year, but this is not the only reason for the deficit. To a great extent it is due to the steady increase in the amount of material published in the *Journal* and *Proceedings*, details of which are shown on page 400. This item alone cost £10 500 more than we had estimated. The acceptance of a paper is governed only by its standard and not by any financial considerations. Members will, I am sure, agree that this is the proper policy, particularly as these publications must invariably be the main connecting link between The Institution and most of its members. It is hoped that increasing subscriptions and sale of these publications, together with an increase in the advertisement revenue, will improve the income from this source and will materially reduce the net cost in future years.

'Let me now deal briefly with other items of expenditure. Under the heading of "Management" the total cost is £9 000 above that of last year, owing to increased activity resulting in the need for more staff, to the normal salary increases, and to higher starting salaries now prevailing in the junior grades.

'Printing and stationery cost £1 100 more than last year, but this is partly because Part I of the List of Members was reprinted in 1955. This is considerably more expensive than Part II.

'There is an apparent saving in the cost of the Institution building of £1 800, which, however, exists only because in the previous year the amount transferred to the Repairs Suspense Account was £6 000 instead of £4 000. The true result is, therefore, a small increase in costs.

'Furniture and fittings, as well as repairs and renewals, cost more, but we do all we can to restrict expenditure as much as is consistent with satisfactory operation.

'I have already referred to the *Journal* and *Proceedings*, and the next item to show a marked increase is Local Centre expenditure, which is up by over 10 per cent. Here again, growth in membership and general rising costs are the reasons.

'There is a fall in the cost of conferences. This is because the Conference of the Engineering Societies of the Commonwealth held in London in 1954 was rather expensive. The small charge shown for 1955 is a final adjusting payment for that Conference. There is one new item under this heading, the British Nuclear Energy Conference, which cost £354 in 1955. It is a Conference set up by five professional societies and is one in which our Institution is vitally concerned.

'You will notice a payment of £500 as a contribution to the cost of producing the film *The Inquiring Mind.* The major part of the cost of the film was met from subscriptions received from a number of organizations.

'The remaining items of expenditure compare favourably with the previous year, and generally there is a slight increase. Of course, the ever-rising activity of The Institution makes this inevitable.

'The statement of income requires very little comment. You will see that the subscription income shows the normal increase, again representing the growth of The Institution. There is a big jump in receipts from the sales of The Institution's small publications, and most of this arises from the excellent sales of the 13th Edition of the Regulations for Electrical Equipment of Buildings. Copies are still selling well, but the receipts for 1956 will not equal last year.

'Turning to the Balance Sheet, you will find on page 402 that the excess of expenditure over income for the year has been met from the General Reserve Fund and does not affect The Institution's capital account, i.e. the surplus of assets over liabilities. You will notice, too, that the Rebuilding Fund has been fully invested and that the investments held in the General Reserve Fund have been reduced to meet the loss incurred. The investments which are not covered by either of the Reserve Funds, and which are valued at £4209, have been transferred to a General Investment Fund.

'There are two new funds appearing this year in the Trust Funds Account, the William Geipel Scholarship Trust Fund and the Henry Nimmo Premium Fund. The latter fund was subscribed by members of the Board of the Southern Electricity Board for a premium in memory of their first Chairman.

'My first report, I am afraid, is not a happy one. We can have every assurance that every item of expenditure is being carefully watched, but we cannot immunize ourselves from the inflationary events which affect everybody.

'I move that the Accounts be received and adopted.'

Mr. W. Holttum seconded the motion for the adoption of the Accounts. No observations on the Accounts being made by members present, the President put the motion to the meeting, and it was carried unanimously. The Auditors, Messrs. Allen Attfield and Co., were reappointed for 1956.

The President then formally thanked, on behalf of the meeting, the Secretary and his staff for the way 'in which they are carrying out their duties and dealing with problems of increasing technical complication in coping with the difficulties of inflation'.

Next **Dr. E. Wilkinson** proposed: 'That the best thanks of The Institution be accorded to the Honorary Secretaries of the Local Centres, of the Sub-Centres, and of the Oversea Branches and Committees, and to the Oversea Representatives of the Council, for their valuable work during the past year. The resolution was seconded by **Mr. A. R. Blandford** and carried with acclamation.

Mr. T. E. Goldup proposed and **Mr. G. L. Wates** seconded a vote of thanks to the Hon. Treasurer, which was carried with acclamation.

This concluded the business of the Annual General Meeting, which was followed by a lecture given by **Sir Gordon Russell** on 'Appearance Design'. It is intended to publish the text of this in a future issue of the *Journal*.

E.R.A. Annual Report

The 35th Annual Report of the British Electrical and Allied Industries Research Association, for the year ended the 31st December, 1955, has recently been published. This booklet gives an account of the activities of the Association in 1955, including a summary, under eighteen different headings, of the research carried out. All the reports issued during the year are listed.

The President of The Institution is greeted by Mr. M. D. Hooven, President of the American Institute of Electrical Engineers in the Engineer's Club, New York, on the 21st May this year (*See p. 443*)

The Convention on Electrical Equipment of Aircraft

Some details from the programme of The Institution's Convention on Electrical Equipment of Aircraft, which was held from the 2nd to 4th May this year, were published in the April *Journal*, and short reviews of the papers read at it will be published in future issues. It is pleasant to record that the attendance far exceeded the expectation of the organizers and that only in the final session was there room to spare in the Lecture Theatre. The audience included visitors from France, Germany, Holland, Sweden and America. One of the American visitors, Mr. L. H. Hildebrandt of Ohio, made a greatly appreciated contribution to the final discussion. Another important visitor was Mr. E. T. Jones, President-elect of the Aeronautical Society, who opened the discussion on Mr. S. F. Follett's paper.

The President, Sir George Nelson, was the Chairman for the first session and he introduced the Minister of Supply, Mr. R. Maudling, as the opening speaker. The Minister, in wishing the Convention every success, spoke of the importance to the country of those two great industries whose representatives were taking part in the Convention, the aircraft industry and the electrical industry. Such a Convention as this must have excellent and far-reaching results.

After the President had moved a vote of thanks to the Minister for his speech and for honouring the Convention with his presence, Mr. G. R. Edwards was called on to give his Introductory Talk. Mr. Edwards's main topic was the lack of reliability in electrical equipment for aircraft, and this he emphasized in no uncertain terms. He claimed to be speaking as a 'friend' of the electrical manufacturers, justifying his claim by saying that he was not one of those who believe that electricity in aircraft is both objectionable and unnecessary; he felt that, though it is objectionable, it is unfortunately necessary. Needless to say, the talk was good-humoured as well as critical and was much appreciated by the audience. A vote of thanks to him and to Mr. Follett was later moved by Mr. D. B. Hogg, Chairman of the Utilization Section.

The question of reliability was harped on throughout the Convention and was said to be even more important than weight. But reliability is not susceptible to such accurate measurement as weight, and one speaker pointed out that if increased reliability is offered at the expense of additional weight, no one believes in the reliability while everyone believes in the weight. Another speaker likened the attitude of the aircraft manufacturers on this point to the Victorian business man full of Christian zeal on Sunday, but a different figure altogether behind his desk on Monday.

It soon became clear that there are two opposing 'schools', one consisting of equipment users and the other of equipment makers. The clash of ideas and opinions between them continued throughout the Convention and was never really reconciled. The controversies were considerably enlivened but not much elucidated by the intervention of members from the Air Ministry and the Government research establishments.

Speakers from every group advocated simplicity, both as a contribution to reliability and as an aid to maintenance. One went so far as to suggest more plug-in components for ease of test and replacement, but the proposed introduction of yet more plugs and sockets was too much for the representatives of aircraft makers to stand. Indeed, in a moment of inspiration, Dr. D. C. Flack likened it to placing water pipes outside the house to make them readily accessible when frozen. Nevertheless the theme of simplicity was raised almost as frequently as reliability.

A 'battle of the systems' could obviously be expected, and Mr. Edwards fired an opening shot in his Introductory Talk by expressing affection for 28 volts d.c. Systems were dealt with in Session 3, and Mr. V. A. Higgs, who opened the discussion at this session, made some qualified objections to a.c. But most of those who followed blandly assumed that some form of rectified a.c. would be the system of the future, and the advocates of d.c. seemed half-hearted about it. Perhaps they were unduly depressed by Capt. P. P. Eckersley's remark, during the first session, to the effect that one outstanding advantage of d.c. was that Mr. Edwards and his colleagues could understand it.

In all the discussions the number wishing to contribute was so large that the time of each speaker had to be limited to five minutes. Most of them had difficulty in keeping within the limit and had to leave much unsaid. On one occasion the audience assisted the chairman by releasing a burst of applause at what was intended to be a temporary pause, and the speaker tactfully and cheerfully accepted the hint. At the end of each session votes of thanks were moved by the chairman to all the authors at that session.

No papers were presented at the final session, but Installation and Maintenance were discussed. At the close Mr. B. L. Metcalf, chairman for the session, called on Mr. Humphrey Davies for a closing talk. After thanking the Institution staff and the members of the panel charged with preparing the Convention on behalf of the Utilization Section Committee, Mr. Davies said that as a result of the Convention at least one paper each year should appear dealing with the electrical equipment of aircraft. He also thought it desirable for a joint discussion to be held during the coming winter with the radar designers, who, although not represented at the Convention, had received a share of the criticisms.

Mr. Metcalf then closed the Convention. The number of papers presented was greater than could be fully assimilated and discussed in the time. Some of them were outstandingly good. The undoubted success of the Convention was largely due to the efforts and skill of Mr. Humphrey Davies, Chairman of the panel mentioned above.

W. J. G.

ANNUAL REPORT FOR 1955-56

Report of the Council presented at the Annual General Meeting on the 17th May 1956

INTRODUCTION

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SECTION B Institution Activities
SECTION C Technical Investigations
SECTION D Joint Activities with Other Bodies
SECTION E Education
SECTION F Institution Library and Publications
SECTION G Benevolent Activities
SECTION H Institution Staff

Appendices

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APPENDIX B Growth of Membership over the last 15 years
APPENDIX C Meetings
APPENDIX D Organization and Government of The Institution

Introduction

On the occasion of this the Eighty-Fourth Annual General Meeting of The Institution the Council have pleasure in presenting their Report for the year ended 31st March, 1956. They are confident that members of The Institution will find much of interest in this record of the work that has been accomplished during the year.

The problem of increasing recruitment to the profession continues to receive the Council's attention, since the numbers of new entrants to a career in electrical engineering are still insufficient to meet the national need. Means of remedying this situation are being actively sought and the subject of technological education has therefore been of considerable interest to the Council and has received much attention from the Joint Advisory Committee on Education of the three senior engineering Institutions. The announcement by the Minister of Education in July, 1955, that he proposed to implement a scheme based on the recommendations of the National Advisory Council on Education for Industry and Commerce for the establishment of a Council for Technological Awards was received with some concern, as the proposals appeared to differ from those previously communicated to the Minister by the three Institutions. Subsequent discussions with the Minister and with Lord Hives, the Chairman of the Council for Technological Awards, have gone a long way to meet the views held by the three Councils on the requisite standards of the new awards in engineering. The Council are keeping in close touch with the development of the scheme through their representatives on the new Board of Studies in Engineering of the Hives Council.

The White Paper on Technical Education (H.M.S.O. Cmd. 9703) has received close attention, and the Council were very pleased to note that many of the proposals that they and the Councils of the other two Institutions have been advocating in recent years are set out in the White Paper.

Reference was made in the Annual Report for 1954–55 to the Committee set up by the Council to investigate the causes of the fall in Student membership. This Committee's report has been received and studied by the Council who, as a result, have introduced a number of measures, details of which are given elsewhere in this Report, which it is hoped will increase the number of applications for Student membership.

As part of the Council's policy of encouraging more boys and girls, particularly those from grammar and public schools, to look to electrical engineering as a career, a display stand concerned with electrical engineering has been prepared for use at careers meetings and careers exhibitions. Experience has shown that these exhibitions provide an excellent opportunity to promote interest in electrical engineering as a career.

The Institution's new careers film *The Inquiring Mind* received an excellent reception at its first showing in June, 1955. It is directed primarily to senior boys in public and grammar schools, particularly those who may not have realized the opportunities offered by a career in electrical engineering.

As a result of the Council's interest in the provision of adequate courses for electrical technicians, and of the conferences on this subject which they have sponsored, the City and Guilds of London Institute have prepared regulations and syllabuses for the conduct of examinations for electrical technicians.

Additionally, The Institution, in furtherance of its work as a learned Society, is arranging three Conventions: two on 'Digital-Computer Techniques' and 'The Electrical Equipment of Aircraft' are to be held during the spring of 1956, and the third on 'Ferrites' will take place in the autumn. In other respects the scale of meetings at home and oversea has been maintained at the previous high level and the Council record that the flow of material of a standard acceptable to The Institution continues unabated, making it necessary to reduce the maximum length of papers from 12 to 10 pages of the *Proceedings*, and to limit the length of each recorded contribution to discussions to 300 words. The *Journal* in its new style has continued to receive the approbation of members.

The Regulations for the Electrical Equipment of Buildings have undergone complete revision and a 13th Edition of the Regulations was placed on sale in September, 1955. To date

over 40 000 copies of the new edition have been sold. A second edition of the Recommended Practice for Electrical Installations in Caravans is being issued. The Council have also authorized the Ships' Regulations Committee to prepare a 4th Edition of the Regulations for the Electrical Equipment of Ships.

The British Nuclear Energy Conference, the formation of which was foreshadowed in the last Report, was inaugurated at a meeting held at The Institution of Civil Engineers on the 30th November, 1955. The first issue of the *Journal* of the Conference appeared in January, 1956; there will be two further issues this year and it is likely thereafter to appear quarterly.

It gives the Council great pleasure to record that Her Majesty the Queen acceded to a Petition by The Institution for the grant of a Supplemental Charter, the full text of which appears in the *Journal* of The Institution for May, 1956.

Following increases in postal charges and in the costs of printing and paper the Council instituted an examination into The Institution's finances, as a result of which economies were imposed. These, however, proved insufficient to meet the deficit anticipated at the end of 1956 and, having regard to the fact that the Council endeavour to preserve intact The Institution's Reserve Fund, they had no option but to seek the approval of Corporate Members to measures which will result in an increase in income sufficient for the Council to do this without curtailing The Institution's present activities.

Consequential changes required in the Bye-laws, as a result of the granting of the Supplemental Charter, were considered at a Special General Meeting of Corporate Members held on the 22nd March, 1956, when a number of other changes to the Bye-laws were put forward, including proposals for increases in the rates of subscription and entrance fees to which reference is made above.

The presence this year, at the Annual Dinner of The Institution, of His Royal Highness the Duke of Edinburgh, who proposed the toast of 'The Institution' gave great pleasure to members, and made the function particularly memorable. The opportunity was taken of presenting to His Royal Highness, who was elected an Honorary Member of The Institution in 1955, his Certificate of Honorary Membership, which was enclosed in a suitably engraved silver-gilt casket. His Royal Highness also signed the Roll of Honorary Members and Faraday Medallists.

The Council again welcome the opportunity given by the presentation of their Annual Report to record their high regard for the services performed for The Institution by the Honorary Officers and other members of The Institution at home and oversea who so loyally and willingly give of their time in the interests of The Institution.

SECTION A **Membership**

1 The Register

The rate of increase in the membership of The Institution has been well maintained, the number of members elected during the year being 1 978 compared with 2 200 in 1954–55. The Membership Committee dealt with 2 836 other applications, mostly for transfer from one class to another, making a total of 4 814 compared with 4 374 in 1954–55. On the 1st April, 1956, there were 32 886 Corporate Members and Graduates on the Register, representing 82·1% of the total membership of 40 038. The total number of Corporate Members exceeds 20 000. The number of Graduates increased during the year to 11 797 (11 153 in 1955).

The Council have approved a number of recommendations which it is hoped will increase, in the course of time, the number of applications for Student membership. The measures include (*a*) the distribution of a pamphlet in popular form aimed at arousing the interest of the prospective member; (*b*) the introduction of a small lapel badge for Graduates and Students and, for all members, an Institution tie; (*c*) a reduced subscription of 10s. payable by Graduates and Students doing their National Service and (*d*) increased emphasis on the desirability of Corporate Members accepting a greater personal sense of responsibility in encouraging prospective members to join The Institution at an early age and subsequently helping them to play a fuller part in the life of The Institution.

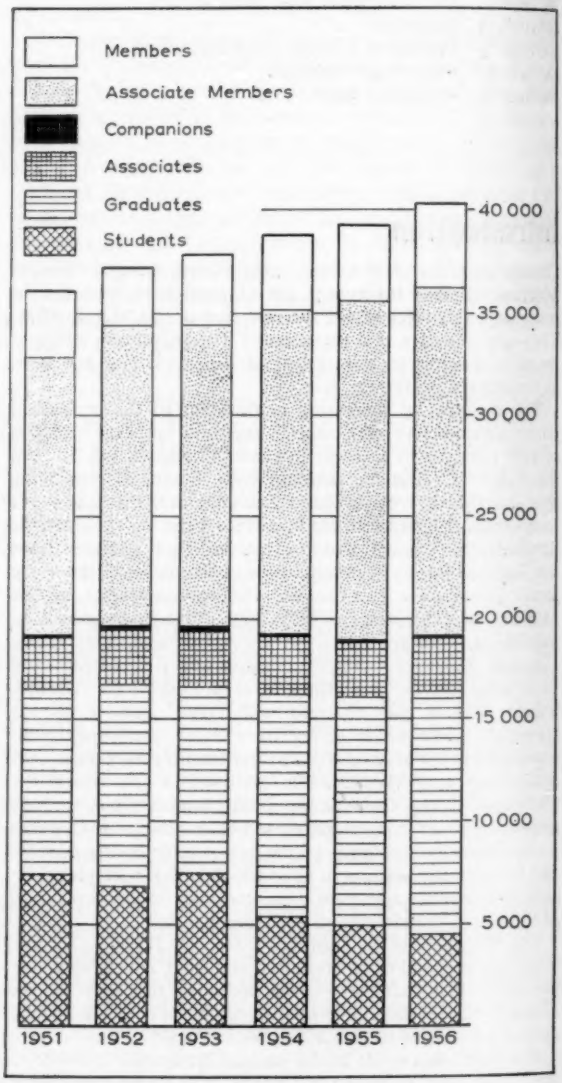

Fig. 1 *Growth of membership*

The operation of Bye-law 16(*b*) under which candidates for Student membership were allowed to defer, until the end of the year in which they reached the age of 23, the production of evidence of having satisfied the requirements of the Common Preliminary Examination, or its equivalent, has received consideration. While the Council feel that no change in the Bye-law is called for, they have nevertheless decided that, henceforward, applications for Student membership should not ordinarily be accepted if the requirement is not met, except where the circumstances are exceptional.

The Council have also decided that a Student on reaching the age of 28 may be allowed an extension of membership of that class provided that it appears likely that he will satisfy the educational requirements for Graduate membership within a reasonable period.

The changes in membership since the 1st April, 1955, are shown in Appendix A, and the growth for the last 15 years in Appendix B. Fig. 1 shows the growth of membership of the various classes during the last six years.

2 Honorary Member

The Council take great pleasure in recording that they have elected Colonel Sir Arthur Stanley Angwin, K.B.E., D.S.O., M.C., T.D., D.SC.(ENG.), PAST-PRESIDENT, to Honorary Membership of The Institution. This honour, the highest within the bestowal of the Council, was conferred in recognition of Sir Stanley's outstanding life's work in the field of telecommunication, both national and international, and of his distinguished services to The Institution. It is interesting to note that Sir Stanley received the Faraday Medal in 1953.

3 Faraday Medal

The thirty-fourth award of the Faraday Medal has been made to Emeritus Professor George William O. Howe, D.SC., LL.D., MEMBER, for his pioneering work in the study and analysis of high-frequency oscillations and on the theory of radio propagation; and for his outstanding contributions to engineering education.

4 Principal Honours and Distinctions conferred on Members

Baronet

NELSON, SIR GEORGE H. (MEMBER).

Knighthood

BISHOP, HAROLD, C.B.E., B.SC.(ENG.) (MEMBER).

Knight Grand Cross of the Order of the Bath

MOUNTBATTEN OF BURMA, ADMIRAL THE RT. HON. THE EARL, K.G., P.C., G.C.S.I., G.C.I.E., G.C.V.O., K.C.B., D.S.O., LL.D., D.C.L., D.SC. (ASSOCIATE MEMBER).

Companion of the Order of the Bath

COUCH, W. C. M., C.B.E. (MEMBER).
MANN, AIR COMMODORE W. E. G., C.B.E., D.F.C. (MEMBER).

Companion of the Order of Saint Michael and Saint George

WILKINSON, E. R. (MEMBER).

Commander of the Order of the British Empire

BOOTH, CAPTAIN C. F., O.B.E. (MEMBER).
LITHGOW, J. C. (MEMBER).
NEW, C. G. MORLEY (MEMBER).
SMALL, A. J. D., B.SC. (ASSOCIATE).
SUTHERLAND, F. N., M.A. (MEMBER).
SWIFT, R. E., B.SC. (MEMBER).

Officer of the Order of the British Empire

ABATE, LT.-COL. A. T., B.SC.(ENG.) R.E.M.E., (ASSOCIATE MEMBER).
BIRD, J. W. G., M.B.E. (ASSOCIATE MEMBER).
FRUGTNIET, A. V. (ASSOCIATE MEMBER).
HOGBEN, L. B. (MEMBER).
HORGAN, LT.-COL. M. O., T.D. (MEMBER).
HUGGETT, W. J. (ASSOCIATE MEMBER).
OATLEY, C. W., M.A., M.SC. (MEMBER).
RAWLINSON, J. D. S., B.SC.(ENG.) (MEMBER).
SIMS, A. E. (ASSOCIATE MEMBER).
SPAGNOLETTI, P. H., B.A. (MEMBER).
THRIPP, GROUP-CAPTAIN G. (MEMBER).
TOOGOOD, H. F. (MEMBER).
WESTON, H. (MEMBER).
WILLIAMS, J. W. M. (MEMBER).

Member of the Order of the British Empire

ADDISON, J. D. (MEMBER).
BOYD, J. M., B.SC.(ENG.) (ASSOCIATE MEMBER).
CHEEL, H. G. (ASSOCIATE).
CURRALL, WING-CMDR. G. H., M.M. (ASSOCIATE MEMBER).
ELLIS, H. D. MCD., M.A. (MEMBER).
ESSEX, G. W. (ASSOCIATE MEMBER).
GUNN, G. (ASSOCIATE MEMBER).
HARRAL, R. H. (MEMBER).
LAMBERT, JAMES E. (ASSOCIATE MEMBER).
ROGERS, D. C. (ASSOCIATE MEMBER).

Member of the Royal Victorian Order

DUNHILL, COMMANDER A., R.N. (ASSOCIATE MEMBER).

Imperial Service Order

WALDRON, E., M.B.E. (ASSOCIATE MEMBER).

2nd Clasp to Territorial Decoration

BANNER, MAJOR E. H. W., T.D., M.SC. (MEMBER).

Emergency Reserve Decoration (Army)

KNIGHT, MAJOR H. E. (MEMBER).
OGDEN, MAJOR H. W. R., R.E. (ASSOCIATE).
SANDERSON, D. H. S. (ASSOCIATE MEMBER).

Volunteer Reserve Decoration (Royal Naval Volunteer Reserve)

WALKER, COMMANDER F., R.N.V.R. (ASSOCIATE MEMBER).

5 Deaths

The Council record with regret the deaths of the following members of The Institution:

Members

Allcock, H.
Allom, G. F.
Ayton, F.
Baldwin, F. G. C., O.B.E.
Bentham, H.
Bland, M. G., O.B.E.
Bowerbank, G., B.SC.
Braby, I.
Bridge, N. C.
Burnand, W. E.
Byng, E. S.
Carr, A. S., M.A.
Carter, F. S.
Cleaver, R. L., B.SC.(ENG.).
Clegg, A. W.
Cooke, W. H.

Members—continued

Cramb, A. C.
Crookes, S. I.
Deane, R. H. A.
Dunton, A. R.
Eden, A. C., B.SC.
Evans, K. R., O.B.E., M.A.
Falk, Lt.-Col. G. F.
Farrer, M.
Farrow, A. E.
Fogarty, L. F. A.
Gadsby, D. J.
Gardiner, J. R.
Garland, J.
Garratt, J. H.
Gilbert, W.
Gill, F. W.
Grierson, R.
Hallam, J. P.
Harris, R. W. L., B.SC.
Harris, T. E., C.B., C.B.E.
Harvey, R. A., B.SC.(ENG.).
Hoadley, E. E., C.B.E.
Illingworth, R., O.B.E.
Johnson, C. V.
Kenny, J. A.
Kerr, T. A.
Kirk, G. R.
Kirke, H. L.
Lakin-Smith, C.
Lamb, J. F.
Lawrie, Lt.-Cmdr. T., C.B.E., M.A., R.N.V.R.
Leggett, B. J., M.R.C.S., L.R.C.P.
Loving, A. J. C.
McKenna, J. J.
MacKenzie, W. A.
Megaw, E. C. S., M.B.E., D.SC.
Monckton, C. C. F.
Newbury, A. D.
North, Major B.
Panton, J. A.
Paton, A. M., B.A., B.SC.
Perrow, E. V.
Pevzner, L.
Pohl, R., D.ENG., D.SC.
Purse, F. W.
Rayner, D. D.
Riviere, P. L.
Rottenburg, H.
Russell, S. G. C.
Shilstone, F. W.
Short, A. H.
Siviour, S. R., O.B.E.
Stevenson, P. R.
Strafford, C.
Strickland, T. P.
Thomson, H. J.
Turner, W. G.
Wainscot, Sqdn. Ldr F. S., R.A.F.
Whillis, C.
Whipp, F.
Wicks, P., B.SC.
Wilmot, L. B.
Wilson, Lt.-Col. J. G.
Wilson, W. S.
Wood, H., M.A.
Yerbury, H. E.

Associate Members

Allen, J. T.
Arnold, C.
Ashton, J. H.
Atkinson, J.
Austin, H. S. E.
Bacon, J. J. C.
Beale, H. R.
Bell, W. H. H.
Bewsher, H. W.
Braathen, E. P., B.SC.
Branczik, E. A. C.
Brand, W.
Brierley, H. H.
Broadhurst, G.
Brown, F. D.
Bunting, J. H.
Burnett, H. R.
Bury, W. E. L.
Campbell, A. C.
Clarke, W. A.
Cuthbertson, C.
Dale, W. B.
Danson, J. R.
Davenport, A.
Davies, H. C.
Dawson, A. J., M.B.E., M.SC.
Dillon-Browne, A. F.
Doudney, S. P.
Downes, F.
Elsden, G. H.
Eustace, J.
Evans, B. A.
Eynon, W.
Fanghanel, W. P. F., B.SC.
Farrell, A. B.
Fella, E. A.
Fox, A. G.
Furness, P.
Glanville, Major G. G., M.C., M.A., B.SC.(ENG)., R. SIGNALS (RET.)
Granger, B. B.
Grasham, F., B.SC.
Guild, J. B.
Gunn, G., M.B.E.
Hart, C. E.
Higham, J., M.SC.
Hilton, R. P.
Hiseman, A. E.
Hodsman, G. W.
Hofman, S.
Howard, C.
Jack, T.
Jackson, E. H. T.
Johnson, R. A.
Lanyon, G. W., O.B.E., B.SC.(ENG.).
Lawes, W. H., B.SC.
Lawson, F. A.
Le Clair, L. J.
Lee, T. F., O.B.E.
Lingard, J.
Lippa, E., DIPL.ING.
Lister, F.
London, T. G.
Macaulay, J. M., B.SC., PH.D.
McCallion, J.
McDermott, J.
Mars, F. J.
Marshall, L. B.
Matthews, T. H.
Morris, A. J.
Morrow, H. E.
Mullin, J.
Nickless, J. E.
Nielsen, O. F. S.
Nightingale, J., B.SC.TECH.
Osment, C. G., B.SC.(ENG.).
Oswald, W. J.
Pearce, H. R., B.SC.TECH.
Penning, S. H.
Penrose, H. E.
Priest, Major F. I. D., T.D., R.E.M.E.
Priestley, A., B.SC.TECH.
Ronald, T. T.
Sanlehi, E. F. C.
Sauermann, J. D., B.SC.
Schumacher, C. G.
Scott, M.

Associate Members—continued

Scott, W. A., M.B.E.
Sexton, F. P.
Sharp, J. T., M.B.E.
Shorland, H., B.SC.(ENG.).
Shuttleworth, W. E.
Sinclair, D.
Slack, C. G.
Smith, J. F.
Sommerville, G. S.
Spence, J.
Spurr, G. R.
Squire, F. E.
Stewart, A. D.
Taylor, E. A.
Tomlinson, Major N. B., R.A.F.
Trackson, P.
Travers, A.
Tucker, Major W. S., O.B.E., D.SC.
Turner, F. E.
Vine, L. N., B.SC.
Waite, W. V., O.B.E.
Wallworth, A. R.
Ward, G.
Watson, J. H.
Webber, F. D.
Wilck, C. A.
Williams, L. A.
Wimberley, Major E. A., O.B.E., B.A.
Worthy, L. F., M.B.E.

Companions

Bishop, W. F.
Hughman, Sir Montague
Pole, Sir Felix J. C.
Legge, Brigadier R. F., C.B.E., D.S.O.

Associates

Anderson-Begg, J. B.
Brooksbank, A.
Campbell, A. M.
Carnegie, G. B.
Clements, F. T.
Edwards, N.
Harris, W. H.
Hewlett, H.
Hooper, S. A. V.
Letchford, H. R.
Long, T. C.
Matthews, S. J.
Parsons, A. D. C.
Pengilly, S. J.
Pointon, H. V.
Rodrigues, J. R.
Stephenson, C. H.
Woods, R. F.

Graduates

Buchanan, J., B.SC.
Clothier, R. W.
Firth, F. N. K.
Gillespie, M. L., B.SC.
Henry, J. A., B.SC.(ENG.).
Jones, S.
Mills, R. W.
Pizzey, J.
Rawnsley, M.
Sangway, J. N., B.SC.(ENG.).
Sedgwick, R. H., B.SC.(ENG.).
Taylor, J. H.
Watkins, D. L.
Wright, R. P., B.SC.

Students

Barfoot, T. W.
Davey, J. F.
Dyne, W. J
Munro, R. J. M.
Reynolds, R. A.
Steadman, K. F.
Thain, M. A.
William, N.

6 Members who have Retired, or who are of Long Standing

During the year, 126 members took advantage of a rule, under which Members, Associate Members and Associates who have retired from the profession may apply to retain their membership without payment of further subscriptions, provided that they have reached the age of 60 and have had 25 years' continuous membership. A comparable rule applies to Companions, who must have reached the age of 70.

Sixty-six members qualified for a total remission of subscription under a rule covering members of any class who have completed 50 years' membership.

7 The Designation 'Chartered Electrical Engineer'

The Council have continued to emphasize the desirability of a wider use of the title 'Chartered Electrical Engineer' and see in the specific reference now included in the Supplemental Charter (see par. 10) a clear pronouncement on its use by Corporate Members, and thereby a greater opportunity of understanding on the part of the public of their professional status.

It has been arranged that the designation will be included on future Diplomas of Corporate Membership.

8 Professional Conduct

Acting in common with the Council of The Institution of Civil Engineers, the Council gave notice in the *Journal* of The Institution for November, 1955, that it would not be regarded as a breach of the provisions of Bye-law 42, and in particular its Sub-section (iii)(*e*) governing professional conduct for consulting engineers, if descriptive brochures conforming to a number of specified particulars were supplied on request to potential clients. The Council expressed their confidence that consulting engineers responsible for issuing such brochures would have due regard to the words of Bye-law 42 concerning the traditions of The Institution and the dignity of the profession.

9 Unauthorized Use of Membership Initials

The Council have continued their firm action in all cases of the unauthorized use of membership initials which are brought to their notice, and during the year have obtained satisfactory undertakings and apologies from five offenders.

The Council will be glad if members will bring the facts of any doubtful cases to the attention of the Secretary.

10 Royal Charter

Her Majesty The Queen has acceded to a petition by The Institution for the grant of a Supplemental Charter. The Letters Patent passed the Great Seal on the 5th March, 1956, and have effect forthwith. The full text of the Supplemental Charter appears in the *Journal* of The Institution for May, 1956.

Its main provisions are to establish that the broad aim in Article 4 of the original Charter 'to promote the advancement of electrical science and engineering and their applications' is not limited or restricted by the specific powers which are enumerated later in that Article. A second Article establishes explicitly that The Institution may remunerate those of its members who render it special services, award scholarships and exhibitions, and award prizes, e.g. for meritorious papers. A third Article reads 'A Corporate Member of The Institution shall be entitled to the use of the style or title "Chartered Electrical Engineer" for so long as he shall be a Corporate Member'. The concluding Article provides machinery whereby a Special General Meeting of Corporate Members can, on a proposal from the Council, recommend amendments to The Institution's Charters for allowance by Her Majesty in Council.

11 Bye-law Revisions

Following the grant of the Supplemental Charter certain consequential changes required in the Bye-laws were brought to the attention of Corporate Members at a Special General Meeting held on the 22nd March, 1956. Opportunity was taken at that meeting to consider a number of other changes including increases in subscription rates and entrance fees; full details will be published in the *Journal* when the desired amendments, all of which were approved, have been allowed by the Privy Council.

SECTION B Institution Activities

12 Meetings

During the 12 months ended the 31st March, 1956, 1 270 meetings of the members, the Council and the various Committees were held in London and at the Local Centres. A detailed statement is given in Appendix C, and Fig. 2 shows the number of meetings held during the past six years. Eight Ordinary Meetings were held in London, with an average attendance of 310 as compared with 314 for the previous year.

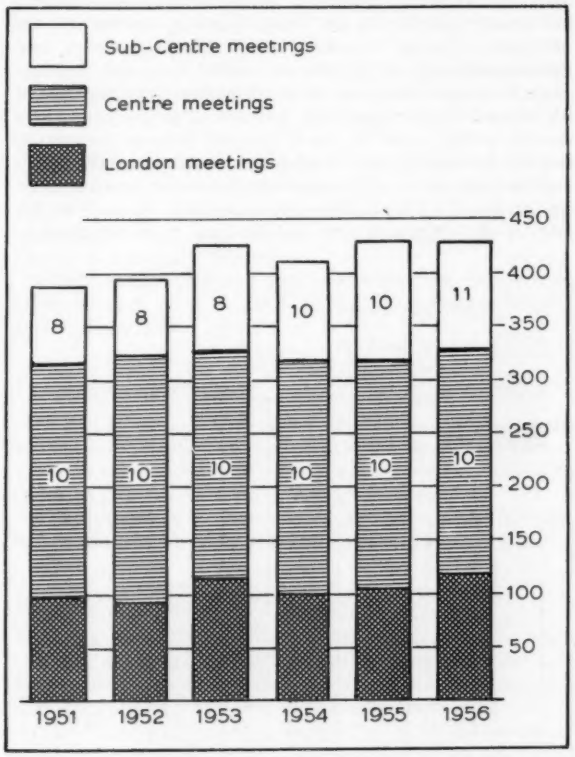

Fig. 2 *Total number of Meetings held in London and in the Centres and Sub-Centres*

The numerals 8, 10 and 11 indicate the number of Centres and Sub-Centres. In 1953 the federated Scottish Centre was formed, and meetings since then have been held under the aegis of the three Sub-Centres in Scotland.

In addition, two Extra Meetings, the Annual General Meeting and two Special General Meetings were held. A number of joint meetings with The Institution of Civil Engineers and The Institution of Mechanical Engineers also took place.

The Second Graham Clark Lecture, arranged this year by The Institution of Mechanical Engineers, will be delivered in April, 1956, by Sir Maurice Bowra, F.B.A., M.A., on 'The Impact of Engineering on Society'. It will fall to The Institution of Electrical Engineers to make the arrangements for the Third Graham Clark Lecture to be delivered during the 1956–57 session.

A public meeting was held at the Central Hall, Westminster, London, for the delivery of the 1955–56 Faraday Lecture by Mr. B. L. Metcalf, B.SC.(ENG.), MEMBER (see par. 21).

The 46th Kelvin Lecture on 'Transistor Physics' was given in the Lecture Theatre of The Institution by Dr. W. Shockley, B.SC.

Reference to the meetings of the four Specialized Sections and the Informal Meetings of The Institution is made in subsequent paragraphs.

13 Specialized Sections

The Council are conscious that electrical engineering is a profession which is expanding into entirely new fields and that The Institution must, as a living organism, continuously re-adapt itself to the requirements of the times. They have therefore reviewed the scope of the Specialized Sections with particular reference to the fields formerly covered by the Technical (Papers) Committees on Electrochemistry and Electrometallurgy, Telegraphs and Telephones, and Traction. They have agreed that the work of the Electrochemistry and Electrometallurgy Committee and the Traction Committee should be taken over by the Utilization Section Committee, and the Telegraphs and Telephones Committee by the Radio Section Committee, which as a consequence has been renamed the 'Radio and Telecommunication Section'. In addition the title of the Measurements Section has been changed to 'Measurement and Control Section' in order to provide a more appropriate description of the ground covered.

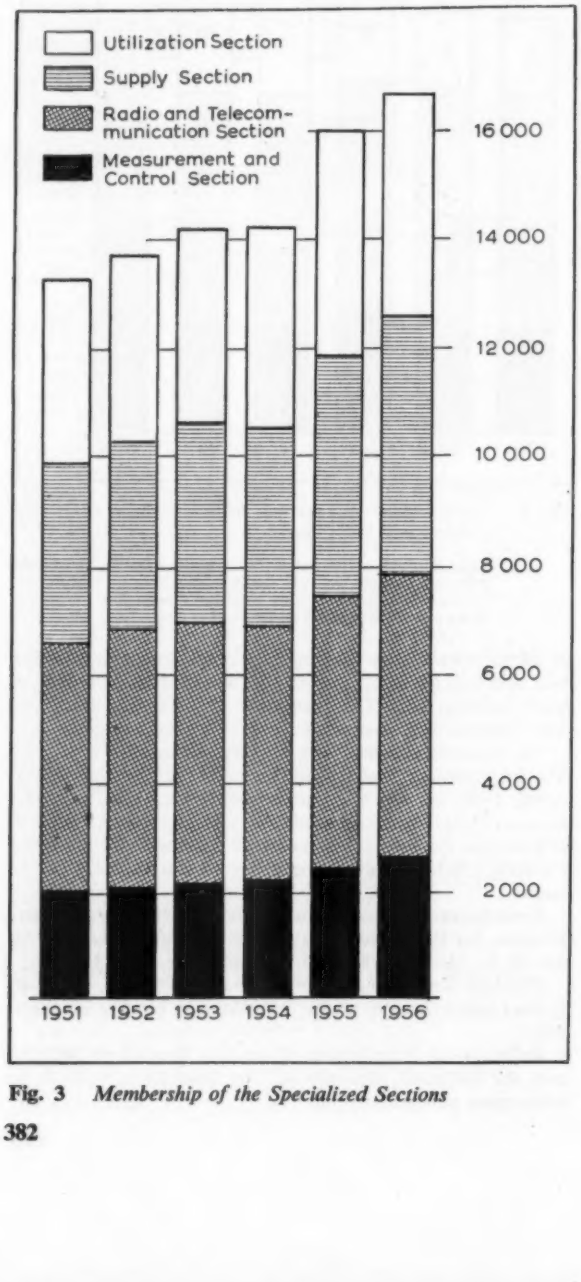

Fig. 3 *Membership of the Specialized Sections*

As will be seen from Fig. 3 the membership of the Sections continues to increase. The following statement shows the membership of the Sections, the number of meetings that have been held and the average attendances:

	Membership at 31st March, 1956	Number of meetings	Average attendance (figures for last year in brackets)
Measurement and Control	2 661	15	61 (65)
Radio and Telecommunication	5 232	15	152 (134)
Supply	4 685	10	147 (157)
Utilization	4 145	8	120 (112)

Measurement and Control Section

The arrangements for the Convention on Digital-Computer Techniques, from the 9th–14th April, 1956, referred to in the last Annual Report, have been completed during the present session in collaboration with the Committee of the Radio and Telecommunication Section and the D.S.I.R. Advisory Committee on High Speed Calculating Machines. With the intention of presenting a programme of interest alike to scientists, engineers and mathematicians, it was arranged that sessions both for specialists and non-experts should be held simultaneously, and that the Convention should conclude with visits to typical computer installations. Over 50 papers were considered for presentation, and lectures and oral contributions by experts were included in the programme.

In addition the Committee have examined 60 other papers submitted either for publication or for presentation at Section Meetings during the session, and, of these, four were at an Ordinary Meeting held under the auspices of the British Nuclear Energy Conference on the 5th April, 1956. The Committee would like again to express their satisfaction that the number of papers sent for their consideration is so well maintained, and they are gratified in that one of the papers was awarded The Institution Premium.

The Annual Lecture was delivered on the 3rd May, 1955, by Professor W. V. Mayneord, D.SC., his subject being 'Some Medical Uses of Radioactive Isotopes'.

The Summer Visit took place on the 17th June, 1955, when members of the Section and their ladies visited the works of Electric and Musical Industries Ltd., at Hayes, and were entertained to lunch at Windsor. Tea was taken in the Royal Horticultural Society's Gardens at Wisley, after which members were received at Horsley Towers by Mr. J. Eccles, C.B.E., B.SC., then President of The Institution, where they inspected the Training Establishment of the Central Electricity Authority, afterwards being entertained to dinner by the Authority.

The Section Dinner was held at the Café Royal, London, on the 8th November, 1955, when 283 members and their guests were present. The Section again joined with the Radio and Telecommunication Section in a very successful Dinner-Dance, also held at the Café Royal, on the 16th March, 1956.

Radio and Telecommunication Section

With effect from the 1st October, 1955, the scope of the Section was widened to incorporate Line Communication which had previously been the concern of the Telegraphs and Telephones Committee, and the title of the Section was changed from 'Radio Section' to 'Radio and Telecommunication Section'.

During the year under review 15 meetings were held. The

programme comprised, in addition to the Opening Meeting, seven Section Meetings devoted to the presentation of papers, a lecture by Dr. E. M. Deloraine on 'Pulse Technique, with particular reference to Line and Radio Communication', three Informal Lectures, one Discussion Meeting and two Informal Evenings at which particular emphasis was given to the use of films and demonstrations.

One hundred and eight papers have been submitted to the Committee for consideration, an increase of 21 on the number considered last year.

The Summer Visit was held on the 25th June, 1955, when a party of more than 200 members of the Section and their guests spent a very enjoyable day at Rugby and Stratford upon Avon. The Section Soirée was held on the 28th November, 1955, when there was an attendance of over 500. In addition to many interesting exhibits and demonstrations, those present were invited, by kind permission of the B.B.C., to attend a performance of the Commonwealth Edition of 'Twenty Questions', which was recorded in the Lecture Theatre.

The concluding social event of the year took the form of a Joint Dinner-Dance with the Measurement and Control Section at the Café Royal on the 16th March, 1956, when more than 300 members and their guests were present.

Supply Section

There has been a shortage of papers suitable for reading at meetings and this has resulted in the introduction for the first time of Discussion Meetings and Informal Lectures. One of the two Lectures was by Mr. F. Bianchi di Castelbianco who talked about the crossing of the Messina Straits by an overhead transmission line. Although this meeting was arranged at very short notice there was an attendance of 200. Only one Section paper has been read at an Ordinary Meeting, compared with five during the previous year.

The social functions have again been outstandingly successful, and have received strong support. For the first time since the War the Section went abroad for their annual Summer Visit, making Amsterdam the centre of a three-day tour. The visit was noteworthy for the number who attended (136 members and ladies), for the excellent weather, for the warm welcome received from numerous Dutch hosts, and for the co-operation of the Netherlands Railways who arranged special trains and free travel tickets.

A repeat visit to the B.B.C. Television Studios and Centre at Lime Grove and White City took place on the 8th October, 1955, and was fully subscribed.

366 members and guests, a record number, attended the Dinner-Dance on the 6th March, 1956, transferred on this occasion from the Café Royal to the Criterion because of the need for more space.

The Committee have made arrangements for a visit to the Houses of Parliament, and the National Maritime Museum and the Royal Naval College on the 5th May, 1956, and for a week-end visit to Northern Ireland in September, 1956.

Utilization Section

The year under review again showed a marked increase in the number of papers received by the Committee, 31 having been considered compared with 22 last year. Of these, 22 were accepted, two being selected for presentation at Ordinary Meetings.

In addition, 18 papers have been accepted for inclusion in the Convention on 'Electrical Equipment of Aircraft' which is to be held from the 2nd–4th May, 1956. The Convention will be opened by The Rt. Hon. Reginald Maudling, M.P., Minister of Supply.

The scope of the Section has been widened by the inclusion of electric traction, previously outside the field of the Specialized Sections and dealt with by the Traction Technical Committee. A special Sub-Committee has been set up to sponsor papers on the subject. The Section Committee has also taken over the work previously carried out by the Electrochemistry and Electrometallurgy Technical Committee.

Dr. W. Grey Walter, M.A., delivered the Section Annual Lecture, taking as his subject 'The Electrical Activity of the Brain'.

The customary Students' papers meeting was not held as none of the papers submitted was considered to be suitable.

The Summer Visit was held at Harwell on Saturday, the 21st May, 1955, its main feature being a tour of the Atomic Energy Research Establishment.

Over 150 members and their guests attended the Annual Dinner-Dance, held at the Café Royal on Wednesday, the 18th January, 1956.

14 Informal Meetings

Informal Meetings have continued to play their part in the activities of The Institution. The keen interest of members in the wide variety of subjects discussed has been evidenced by the good attendance at the seven meetings held.

The proceedings at these meetings are entirely informal, and no reports are published in the *Proceedings* or elsewhere.

15 Local Centres and Sub-Centres

During the year under review 328 meetings of a general character were held by the ten Local Centres and their Sub-Centres and Specialized Groups. The Council regard this level of activity as very satisfactory and reflecting great credit on the local committees concerned. 18 558 members are attached to these Centres, the figures for the individual Centres being as follows:

East Midland	1 567	North-Western	2 962
Mersey and North Wales	1 324	Scottish	1 779
North-Eastern	1 367	South Midland	3 424
Northern Ireland	312	Southern	1 648
North Midland	1 859	Western	2 316

In addition to the General Meetings a number of social functions have been held, at several of which the President, accompanied by the Secretary, was present. The Vice-Presidents have visited all 21 Centres and Sub-Centres and have also deputized for the President at social functions he was unable to attend.

The East Anglian Sub-Centre, which, as foreshadowed in last year's Annual Report, came into operation on the 1st October, 1955, is now holding meetings regularly in Norwich, Ipswich and Cambridge. The Opening Meeting in Norwich on the 12th October, 1955, was attended by Mr. T. E. Goldup, C.B.E., VICE-PRESIDENT, and the Secretary of The Institution, together with other members of Council.

During the year the following Honorary Secretaries of Centres and Sub-Centres have tendered their resignations:

Mr. R. G. L. Ryan, ASSOCIATE MEMBER, East Midland Centre, after five years of service.

Mr. J. L. Egginton, B.SC., MEMBER, South-East Scotland Sub-Centre, after three years of service.

Mr. H. G. Harlow, B.SC., MEMBER, North Midland Centre, after one year of service.

Mr. W. G. Friggens, B.SC.(ENG.), ASSOCIATE MEMBER, North Staffordshire Sub-Centre, after one year of service.

The Council welcome this opportunity of recording their sincere appreciation of the services these members have rendered to The Institution.

The interests of local members of the four Specialized Sections have been met wherever possible by the formation of Specialized Groups, of which there are now eleven. A number of them received visits from the Chairmen of the Sections.

16 District Meetings

District Meetings are now held regularly in many places throughout the country where membership of The Institution is too small to justify the provision of meetings of a more formal type, and are extremely successful. Many members who otherwise would have little opportunity of attending meetings of The Institution are able through these meetings to take part in the discussion of Institution papers. The work performed by the conveners of these meetings is greatly valued by the Council.

17 Graduate and Student Sections

Details of some of the Council's recommendations concerning Student membership are given elsewhere in this Report. It is hoped that the introduction of these measures will benefit the Graduate and Student Sections, and increase the support for their activities.

The Committees of the 17 Sections continue to make every effort to attract members to their meetings, visits and social functions, and there is an indication of an improvement in attendance. In particular, the Students' Lectures by Dr. E. C. Cherry, ASSOCIATE MEMBER, and Mr. A. R. Cooper, M.ENG., MEMBER, have been well supported.

During the year the Council approved a change in the title from 'Students' Section' to 'Graduate and Student Section' as being more representative of the members included in the Sections.

A Conference of Honorary Secretaries of Graduate and Student Sections was held in November, 1955, and as a result of a recommendation made at this Conference, arrangements have been made for each Section to be visited once during the session by a member of the Headquarters' staff or by one of the Editors of the *Students' Quarterly Journal*.

18 Oversea Activities

So far as local conditions will allow, the Oversea Branches and Committees have continued to arrange meetings, visits and social functions for local members. Several senior members whose duties took them abroad very kindly addressed meetings. This type of meeting is much welcomed by oversea members, and senior members who are going abroad and are prepared to address members or present an Institution paper are invited to communicate with the Secretary of The Institution.

Many oversea members have called at Headquarters during the year, more than 150 having signed the oversea register. Letters of introduction have been provided for a large number of members travelling abroad and to other members who have taken up oversea appointments during the year. Very favourable reports have been received of the help given to these members by the Secretaries of the national engineering societies to whom the letters of introduction were addressed and with which The Institution has reciprocal arrangements.

In March, 1955, the Secretary of The Institution visited West Africa and was impressed by the engineering developments going on in that country and by the activities of the West African Joint Oversea Group of the three Institutions.

Details of the bilateral agreements regarding the remission of entrance fees which have been entered into with the Engineering Institute of Canada and with the American Institute of Electrical Engineers were announced in the *Journal* of The Institution for March, 1956.

To meet the wishes expressed by members in Toronto for some form of separate identity, the Council authorized the Oversea Representative for Canada to set up an Advisory Committee there which will arrange social functions, and possibly occasional meetings, especially for local members of The Institution. Their wider interests will continue to be met by the Joint E.I.C./I.E.E. Committee (see par. 48).

The Joint Oversea Groups of the three Institutions in Hong Kong, Singapore and Malaya, Iraq and Persian Gulf, and West Africa have all been very active and have fulfilled a real need for meetings facilities for members of the three Institutions in the parts of the world where they have been formed. The Argentina Joint Group has been experiencing difficulties but efforts are now being made to revive its former activity. It is hoped that the next few months will see the formation of yet another Joint Group in Trinidad.

During the year under review the following Oversea Representatives have been appointed by the Council:

Brazil: Mr. C. H. de Nordwall, MEMBER (in place of Mr. Trevor Rees).

India: Mr. L. W. Brazel, ASSOCIATE MEMBER, as Deputy Oversea Representative.

Near East: Professor R. W. Sloane, M.A., PH.D., B.SC., ASSOCIATE MEMBER, as Deputy Oversea Representative.

19 Annual Dinner

The attendance at the Annual Dinner each year continues to increase and a record total of 1472 members and guests were present at the function this year which was held at Grosvenor House, London, on the 23rd February, 1956.

This was a particularly memorable occasion as the principal guest was His Royal Highness the Duke of Edinburgh who proposed the toast of 'The Institution', to which the President replied. The toast of 'Our Guests' was proposed by Mr. J. Eccles, C.B.E., B.SC., PAST-PRESIDENT, and the reply was given by Sir Cyril Hinshelwood, M.A., D.SC., F.R.S., President of The Royal Society.

As announced in the last Report, His Royal Highness was elected an Honorary Member of The Institution on the 3rd February, 1955, and opportunity was taken of his presence at the Dinner for the President to present to him an engraved silver-gilt casket containing the Certificate of Honorary Membership. After the presentation His Royal Highness signed the Roll of Honorary Members.

A full account of the function appears in the *Journal* of The Institution for April, 1956.

20 Summer Meeting

At the invitation of the Chairman and Committee of the Scottish Centre, a Summer Meeting of The Institution was held in the Highlands of Scotland from the 6th to 11th June,

1955. An account of the meeting, which, despite the rail strike, was attended by 475 members and ladies, was published in the *Journal* for September, 1955, and the warm thanks of The Institution have been expressed to all those who contributed so much to the enjoyment of the members and their ladies.

At the invitation of the Chairman and Committee of the South Midland Centre, arrangements are being made to hold a Summer Meeting in the area of the Centre from the 25th to 29th June, 1956.

21 Faraday Lecture

The Faraday Lecture, which this year carried the title 'Coal Mining Electrically', was delivered by Mr. B. L. Metcalf, B.SC.(ENG.), MEMBER, at public meetings held in Cardiff, Stoke-on-Trent, Nottingham, Manchester, Birmingham, Southampton, London, Sheffield, Newcastle, Glasgow and Aberdeen. An additional lecture was given before an audience of senior schoolchildren in Nottingham in conjunction with the Local Education Authority. The Council are grateful to the National Coal Board for their interest in the production of the Lecture and the support they gave Mr. Metcalf, who is the Board's Chief Engineer.

22 Committee on Electrical Exhibitions

The Committee (convened by the Council and including members nominated by the Central Electricity Authority, the Area Electricity Boards, the British Electrical and Allied Manufacturers' Association and the Cable Makers' Association) have continued to maintain close touch with the authorities of the Science Museum, South Kensington, for the setting up of a new electrical power collection.

Work on the final architectural finish of the Gallery which will house the Collection is well in hand, and the Committee have recently commissioned mural paintings, decorative grilles and the like by well-known artists.

At the time of the I.E.C. meetings in London in June, 1955, and for some months thereafter, a special exhibition on the theme of 'Electrical Measurement' was staged at the Science Museum.

23 Exhibitions of Outstanding Scientific Interest

The Secretary is at all times pleased to receive details, for submission to the Exhibitions Committee, of new developments of scientific interest suitable for exhibition under this scheme, which provides facilities for the display in the Institution building of exhibits dealing with such developments. Subjects which have been shown recently or are in active preparation are:

Applications of Non-linear Resistors.
Radio Frequency-operated E.H.T. Supplies.
Quartz Crystals and their Applications.
Applications of Transistors.
Development of Microphones and Headphones for Aircraft Use.

24 The Organization and Government of The Institution

The general framework of the organization and government of The Institution at home and oversea appears in diagrammatic form in Appendix D.

In wider fields, The Institution plays its part by representation on a large number of bodies having objects cognate with its own, the individual nominations being made by the Council from among the members of The Institution. A list of the bodies on which The Institution is represented has been published in the *Journal* (January, 1956).

SECTION C Technical Investigations

25 Codes of Practice

The Council for Codes of Practice (CP/–), which was reorganized in 1954 with the support of the professional Institutions, continues to operate, within the framework of the British Standards Institution, with the status of a Divisional Council. All the Electrical Codes are now prepared under the supervision of the Codes of Practice Committee for Electrical Engineering (ELCP/–), whose Chairman is Mr. P. V. Hunter, C.B.E., PAST-PRESIDENT, the secretariat for which is provided jointly by The Institution and the British Standards Institution. The Institution continues to provide the secretariat for the majority of the Electrical Code Drafting Committees. Codes dealing with radio interference abatement are referred to in par. 26.

The following Codes have been issued during the year:

C.P. 1004, Part 2: Street Lighting Roads other than traffic routes.
C.P. 1006: General aspects of radio interference suppression.
C.P. 1007: Maintained lighting for cinemas.

An amendment to C.P. 325: Farm and horticultural electrical installations dealing chiefly with mains-operated electric fences has been issued (P.D. 2365).

The following Code has been approved for promulgation:

Use of Electronic Valves, Part III, consisting of:
Section 6: Additional recommendations for photocells.
Section 7: Additional recommendations for transmitting valves.
Section 8: Additional recommendations for cold-cathode gas-filled valves.

The drafting of the following Codes is proceeding:

Earthing (preliminary draft in preparation by the E.R.A.).
Maintenance of electrical switchgear (to be based on B.S.1086).
Maintenance of insulating oil.
Overhead electric power lines.
Selection and installation of electric cooking equipment for schools and catering establishments.
Use of Electronic Valves, Part IV, consisting of:
Section 9: Additional recommendations for magnetrons.
Section 10: Additional recommendations for special-quality valves.

The partial or complete revision of the following Codes is under consideration:

C.P. 321: Electrical installations—general (following issue of 13th Edition of Wiring Regulations).
C.P. 321.101: Choice, installation and maintenance of electric wiring systems.
C.P. 321.102: Installation and maintenance of electrical machines, transformers, rectifiers, capacitors and associated equipment.
C.P. 323: Private electric generating plant.
C.P. 324.102: Provision of electric lighting in schools.
C.P. 324.201: Installation of domestic electric space-heating equipment.
C.P. 326.101: Protection of structures against lightning.
C.P. 327.101: Telephones and telegraphs—public services.
C.P. 327.102: Telephones and telegraphs—private services.
C.P. 327.201: Broadcast reception—sound and television by radio.
C.P. 327.404/402.501: Electrical fire alarms.
C.P. 1002: Abatement of radio interference from electro-medical and industrial radio-frequency equipment.
C.P. 1003: Installation and maintenance of flameproof and intrinsically-safe electrical equipment for industries other than coal mining.

Contact continues to be maintained with Oversea Representatives of the Council and Secretaries of Oversea Branches and Committees, to whom new Codes and drafts are circulated.

26 Committee on Radio Interference

Exploratory work on the need for interference abatement in the higher-frequency broadcasting and television bands

(Bands II and III) is being continued by a number of the bodies represented on the Committee on Radio Interference.

The activities of a number of Sub-Committees, convened jointly by The Institution and the British Standards Institution, who are examining various technical issues—one of which deals with relations with the special international Committee on Radio Interference (C.I.S.P.R.)—have continued to receive the support of the Committee. The Committees dealing with Codes of Practice, which now come under the aegis of the Codes of Practice Committee for Electrical Engineering (ELCP/–), maintain liaison with the Committee on matters of policy, and with Technical Committee ELE/32 of the British Standards Institution on matters of standardization.

C.P. 1006, 'General Aspects of Radio Interference Suppression', the preparation of which was initiated by the Committee, was issued during 1955. The problem of abatement of interference from electromedical and industrial radio-frequency equipment has received further study by the Code Drafting Committee dealing with this subject.

The advice of the Committee continues to be available to the Postmaster General on any matters within their purview which may arise.

27 Committee on Regulations for the Electrical Equipment of Aircraft

The Committee, together with the Committee on Radio Equipment for Civil Aircraft, are considering proposals by the Air Registration Board for the amendment of the non-mandatory part of the British Civil Airworthiness Requirements which deals with voltage and frequency tolerances in aircraft electrical supplies.

Liaison with the Committee on Radio Equipment for Civil Aircraft (see next paragraph) and with the British Standards Institution has been maintained, and a number of draft British Standards for aircraft electrical apparatus have been scrutinized.

28 Committee on Radio Equipment for Civil Aircraft

Pending the outcome of the joint discussions on the problems of supplies for radio equipment, in relation to power-system regulation (referred to in the previous paragraph), the Committee on Regulations for the Electrical Equipment of Aircraft have recommended an interim revision of part of Section R in this respect, which has been accepted by the Ministry of Transport and Civil Aviation and would enable the use of regulators in airborne equipment to be dispensed with in certain instances. Liaison is maintained with the Code Drafting Committee on the Use of Electronic Valves, who are drafting further parts of C.P. 1005.

During the session the Committee were requested by the Air Registration Board to consider the practicability of specifying maximum tolerable levels of radio interference from complete electrical installations in aircraft, and studies are proceeding.

29 Model Forms of General Conditions of Contract

The Joint Committee have approved a draft of a new Model Form B.1—Export Contracts, with delivery f.o.b. or c.i.f., which is being placed before the Council of The Institution and the Council of The Institution of Mechanical Engineers for their authority to promulgate.

The Joint Committee have agreed that the work of preparation of further Model Forms to complete the range for export contracts should proceed in the following order:

B.2—Export Contracts with delivery f.o.b. or c.i.f., including Supervision of Erection.

B.1.SF.—Export Contracts with delivery f.o.b. or c.i.f. (Short Form).

B.4—Export Contracts with delivery f.o.b. or c.i.f., including Erection on Site.

[The existing Model Form B.2 (1928)—Export—including Erection or Supervision of Erection, continues, pending publication of the proposed new Model Form B.2, to be available for use in electrical export contracts involving supervision of erection only. Model Form B.3—Export Contracts, including Delivery and Erection on Site, was published in May, 1954.]

In the range of Model Forms for Home Contracts, a complete draft of a revised Model Form 'C'—Home Contracts, without Erection, is being placed before the Council of The Institution and the Council of The Institution of Mechanical Engineers for their authority to promulgate.

30 Study Committee on Basic Design Temperatures for Space-Heating Installations

The Report of this Study Committee, which was set up in April, 1950, on the invitation of the Minister of Works, by the Councils of The Institution of Mechanical Engineers, The Institution of Electrical Engineers, The Institution of Gas Engineers, and The Institution of Heating and Ventilating Engineers, under the Chairmanship of Sir David Brunt, M.A., SC.D., F.R.S., was published by Her Majesty's Stationery Office on the 8th March, 1956, as No. 33 in the series 'Post-War Building Studies'. It makes proposals for a method of selection of basic design temperatures related to the type of structure of the building concerned and the climatic behaviour of the locality.

31 Wireless Telegraphy Act, 1949

Acting under the provisions of this Act, the President and Council have nominated the following to the Panel from which the Postmaster General's Advisory Committees are appointed: Mr. P. Adorian, MEMBER, Mr. P. A. T. Bevan, B.SC., MEMBER, and Mr. H. Faulkner, C.M.G., B.SC.(ENG.), MEMBER. The Institution continues, jointly with the Post Office, to provide the secretariat for the Postmaster General's Advisory Committees on Radio Interference.

32 Postmaster General's Advisory Committees on Ignition Systems, Refrigeration Apparatus and Small Motors

The Wireless Telegraphy (Control of Interference from Ignition Apparatus) Regulations, 1952 (S.I. 1952, No. 2023), came into operation on the 1st July, 1953. During the session the Advisory Committee on Wireless Interference from Ignition Systems were requested by the Postmaster General to review the earlier findings on which these Regulations were based and to give their views on a number of specific questions: a report on these was submitted to the Postmaster General in January, 1956.

On the basis of the Reports of the Advisory Committees on Refrigeration Apparatus and Small Motors respectively, the

Postmaster General has made the following Regulations which were laid before Parliament on the 1st March, 1955, and came into force on the 1st September, 1955:

S.I. 1955, No. 291, The Wireless Telegraphy (Control of Interference from Electric Motors) Regulations, 1955.
S.I. 1955, No. 292, The Wireless Telegraphy (Control of Interference from Refrigerators) Regulations, 1955.

The former relates to small motor-driven appliances which cause interference while in use, whilst the latter relates to new refrigerators when placed on sale. In a Press release the Post Office drew attention to the advice of the Advisory Committees regarding the need for earthing, particularly where capacitor suppressors were used.

33 Economic Commission for Europe: Working Party on International Forms of Contract for Heavy Engineering Equipment

Eleven sessions of the Working Party have been held in Geneva since its formation in 1951.

On the nomination of the Councils of The Institution of Mechanical Engineers and The Institution of Electrical Engineers, H.M. Government appointed Mr. J. F. St. G. Shaw, B.SC.(ENG.), MEMBER, to serve as one of the U.K. delegates to the Eighth and subsequent sessions of the Working Party. Mr. K. F. A. Johnston, B.A., the second nominee of the two Institutions, and Mr. H. B. Morton, continue to serve.

The above named are members of both the Joint Committee with The Institution of Mechanical Engineers and The Institution's own Committee on Model Forms of General Conditions of Contract.

34 Extra-Mural Committee on the Application of Electricity to Industrial Process Heating

The Extra-Mural Committee on the Application of Electricity to Industrial Process Heating, of which Sir John Hacking, Past-President, is Chairman, provides the British link with the International Bureau on Electro-Heat.

Its terms of reference are 'to discuss, co-ordinate and foster activities likely to advance the application of electricity to industrial process heating and to report from time to time to the Council of The Institution of Electrical Engineers'.

The Council have endorsed a recommendation from the Committee that the International Bureau should be invited to consider whether they would accept the membership of the Committee as an affiliate rather than as a full member.

SECTION D Joint Activities with Other Bodies

35 Co-operation between Engineering Institutions

The Institution of Civil Engineers, The Institution of Mechanical Engineers, and The Institution of Electrical Engineers have maintained their close collaboration on matters of common concern. Meetings of the three Presidents have been held, at which views have been exchanged, and common policies and actions agreed upon in appropriate cases.

In the field of engineering education the advice and support of their Joint Advisory Committee on Education have been available to the three Presidents.

36 Parliamentary and Scientific Committee

As a consequence of The Institution's having become an Associated Member of this Committee, Sir Harold Bishop, C.B.E., B.SC.(ENG.), PAST-PRESIDENT, has been appointed the Council's representative on its General Committee. Sir Harold and the Secretary have been appointed to attend its Annual General Meeting.

The Parliamentary and Scientific Committee provides a meeting place for Members of Parliament on the one hand and representatives of the pure and applied sciences on the other, and while of an unofficial character, has performed useful service in emphasizing the scientific viewpoint in relation to matters of national concern.

37 The British Nuclear Energy Conference

Acting in concert with the Councils of the two sister engineering Institutions and The Institution of Chemical Engineers and The Institute of Physics, the Council participate as founder members in the British Nuclear Energy Conference and have appointed Mr. J. Eccles, C.B.E., B.SC., PAST-PRESIDENT, Dr. Willis Jackson, D.SC., DR.SC.TECH., F.R.S., VICE-PRESIDENT, and the Secretary, as The Institution's representatives on the governing body of the Conference.

The Conference acts to co-ordinate the work of the adhering societies in the technology of nuclear energy and arranges an ordered programme of meetings, a proportion of which are joint meetings, and also publishes a jointly produced *Journal* in which successive British advances in the field are recorded.

The work of the British Nuclear Energy Conference was inaugurated at a meeting held on the 30th November, 1955, at The Institution of Civil Engineers, when a series of papers was delivered and discussed. The first issue of the *Journal* of the Conference appeared in January, 1956, and will be followed by two further issues this year; subsequently it is likely to appear quarterly.

38 British Council

The work of the British Council has continued to receive support, in particular through the service of Mr. T. G. N. Haldane, M.A., PAST-PRESIDENT, on its Science Advisory Committee, and of the Secretary on its Science and Engineering Panel.

Contact is maintained with the Science and Engineering and Visitors' Departments of the British Council to ensure that persons visiting this country under its auspices, whose interests lie in the field of electrical engineering, are given the opportunity of visiting The Institution for discussions and to take part in its technical activities.

The work of the Soviet Relations Committee of the British Council (see par. 57) has also been supported.

39 British Standards Institution

Support for the work of the British Standards Institution has been maintained. Particulars of the Council's representation on the Engineering Divisional Council, the Electrical Industry Standards Committee, the Telecommunication Industry Standards Committee, the Illumination Industry Standards Committee and many Technical Committees dealing with British Standards were published in the *Journal* for January, 1956.

The preparation of Codes of Practice is dealt with in par. 25.

The British National Committee of the International Electrotechnical Commission is dealt with in par. 51.

40 Electrical Research Association

The Institution has continued its support for the work of the British Electrical and Allied Industries Research Association. Professor J. Greig, M.SC., PH.D., MEMBER, and Mr. A. W. Montgomery, O.B.E., B.SC.TECH., MEMBER, serve on its Council as the nominees of the Council of The Institution.

41 Professional Engineers Appointments Bureau

The Council's interest in the operation of the Bureau has been maintained and their representatives continue to serve on the Board of the Bureau and on its Electrical Engineering Committee. The Bureau has been active in making nominations to supply vacancies and in other ways, and in particular its advisory services were extensively used by engineers and employers on a number of matters relating to employment. [An account of the work of the Bureau was published in the *Journal* in March, 1955.]

42 Technical and Scientific Register, Ministry of Labour and National Service

The Electrical Engineering Advisory Committee, under the Chairmanship of Sir Arthur P. M. Fleming, C.B.E., D.ENG., LL.D., PAST-PRESIDENT, have considered a progress report prepared by the Electrical Engineering Section of the Register and other matters of importance to the work of the Register.

The Council again appeal to employers not to insist upon too low an age when submitting particulars for vacancies.

43 Engineers' Guild

With the Councils of the two sister engineering Institutions, the Council have continued to participate in meetings of the Joint Consultative Committees of the four organizations, which has the following terms of reference:

'To consider matters of common concern to the three Institutions and to the Engineers' Guild and to report as necessary to the respective Councils.'

44 National Inspection Council for Electrical Installation Contractors

As a further step in the setting up of the National Inspection Council the Council have nominated Mr. P. V. Hunter, C.B.E., PAST-PRESIDENT, and Mr. Forbes Jackson, MEMBER, as their representatives on the National Inspection Board, which will carry out the executive functions of the new organization.

45 British Electrical Power Convention

The Council continue to support the British Electrical Power Convention and are represented on the Council of the Convention by Mr. R. W. Mountain, B.SC.(ENG.), MEMBER, with the Secretary as deputy.

46 Conference of Commonwealth Engineering Institutions

In their capacity as the Executive Committee of the Commonwealth Engineering Conference, the three Presidents have met to discuss items of Conference business, and in particular to consider the date of the next meeting of the Conference. At the invitation of The Institution of Engineers, Australia, with the support and collaboration of The New Zealand Institution of Engineers, this is to be held in Sydney at the end of March, 1958.

47 EUSEC—Conference of Representatives from the Engineering Societies of Western Europe and the United States of America

A meeting of the EUSEC Conference was held in Copenhagen in September, 1955, The Danish Institution of Engineers acting as hosts. The recommendations of the Conference have been adopted by the Council of The Institution with one reservation, a note of which has been taken by the Conference Secretariat, and a number of resolutions of the Conference concerning the future conduct of its affairs have been endorsed.

When the action of the Councils of the remaining members of the Conference on its recommendations are known they will be published with the Resolutions of the Conference in the *Journal* of The Institution.

In addition to attending the business meetings of the Conference the delegates took part in a series of social engagements and visits of engineering interest arranged by their hosts.

At the invitation of the American member societies the next meeting of the Conference will be held at the end of April, 1958, in New York.

48 Engineering Institute of Canada

The increased collaboration between The Institution and the Engineering Institute of Canada which followed the visit to Eastern Canada in 1952 of Sir John Hacking, as President, and the Secretary, has continued.

In Toronto, papers from Institution sources have helped in the provision of programmes of particular interest not only to our own members, but to members of the Engineering Institute whose work is primarily electrical.

The conditions governing the reciprocal waiving of entrance fees for the members of the one Society who are resident in the territory of the other have recently been broadened to apply to members of all grades and will be interpreted liberally. It remains a condition under the arrangements that the first application for election must be made within twelve months of taking up residence.

49 American Society of Mechanical Engineers: 75th Anniversary

Mr. R. H. Barclay, MEMBER, the Honorary Secretary of the Council in the United States, represented The Institution at the 75th Anniversary Celebrations, which were held in Boston, Massachusetts, from the 19th to 24th June, 1955.

The Meeting was also attended by Sir Vincent de Ferranti, M.C., PAST-PRESIDENT, when Honorary Membership of The American Society of Mechanical Engineers was conferred upon him.

50 Verein Deutscher Ingenieure Centenary

Mr. T. E. Goldup, C.B.E., VICE-PRESIDENT, has been appointed to represent The Institution at the Centenary Celebrations of this Society, which are being held in Berlin from the 12th to 15th May, 1956.

51 International Electrotechnical Commission

Four members of the British National Committee of the I.E.C. are nominated by the Council, and are chosen so that the aspects of illumination and telecommunication, as well as electrical engineering generally, are represented.

The Council also support the work of the I.E.C. through the service of their nominees on corresponding B.S.I. Committees, and in particular by authorizing the Committee on Regulations for the Electrical Equipment of Ships to act on the invitation of the British National Committee as the United Kingdom Committee for matters concerning I.E.C. Technical Committee No. 18—Electrical Installations in Ships (see par. 87).

A series of I.E.C. meetings was held in London in June, 1955, the British National Committee acting as hosts. A Reception to the delegates was held in the Institution building on the 29th June, 1955.

52 International Atomic Energy Conference

Dr. Willis Jackson, D.SC., DR.SC.TECH., F.R.S., VICE-PRESIDENT, was appointed by the three Presidents to represent the Engineering Institutions at the International Atomic Energy Conference which was held in Geneva from the 8th to 20th August, 1955.

53 International Conference on Fatigue of Metals

In response to an invitation from The Institution of Mechanical Engineers, the Council appointed Mr. G. R. Peterson, B.A., MEMBER, to represent The Institution on the organizing Committee of this Conference, which is to be held in London in September, 1956.

54 Commission Mixte Internationale

Mr. P. J. Ryle, B.SC.(ENG.), MEMBER, continues to act as the Council's representative on the Commission Mixte Internationale, which is concerned with studies for limiting the interaction of power and telecommunication systems.

55 World Power Conference

Support for this International Conference, whose Secretariat is centred in London, continues.

Mr. J. R. Beard, C.B.E., M.SC., PAST-PRESIDENT, serves as the Council's representative on the British National Committee of the Conference.

56 International Commission on Illumination (C.I.E.)

The Council continue their support of the C.I.E. through their adherence to the National Illumination Committee of Great Britain. Under the constitution of this Committee, The Institution, as one of the three sponsoring bodies, fills one of three seats on its Committee of Administration.

On the appointment of the Council, Dr. J. W. T. Walsh, O.B.E., M.A., MEMBER, represented The Institution at the 13th Plenary Meeting of the C.I.E. which was held at Zürich from the 13th to 22nd June, 1955. At this meeting Dr. Walsh was appointed President of the C.I.E. for the current period until the next session which will be held in Belgium in 1959. A report on the Zürich Meeting by Dr. Walsh was published in the *Journal* of The Institution for October, 1955.

57 Soviet Relations Committee

In common with the Councils of the two sister engineering Institutions the Council have supported the work of the Soviet Relations Committee of the British Council, set up by Her Majesty's Government to facilitate interchanges of teams of experts in various fields of activity between the two countries.

Arrangements in the engineering field are being handled by the three Institutions, who are planning visits to the Soviet Union by teams from this country interested respectively in higher technological education and in hydro-electric power. They are in touch with the Central Electricity Authority, who are organizing a British team concerned with all aspects of the thermal generation of electric power and its distribution, and are receiving a corresponding team of Russian experts.

SECTION E Education

58 Education and Training

The Education and Training Committee have met 14 times during the year. Amongst the most important topics discussed has been the subject of technological education, in which a significant advance has been made by the establishment of the Council for Technological Awards and the presentation to Parliament of a White Paper on Technical Education (see par. 59).

During the year steps have been taken to implement the Council's policy to stimulate recruitment to the electrical engineering profession. The film *The Inquiring Mind* was completed in June, 1955 (see par. 61).

The Institution has also taken part in several careers exhibitions and has been represented by speakers on careers in electrical engineering at schools in various parts of the country.

A new development which is likely to have far-reaching effects on the technical staff in industry is the introduction of new examinations for electrical technicians which has resulted from the deliberations of the Education and Training Committee (see par. 72). Associated with this new qualification is the problem of deferment of call-up for National Service of technicians under training. Discussions have taken place with the Ministry of Labour and National Service following which the Council have offered to act in an advisory capacity to the Ministry in regard to the suitability of courses and the practical training being given to electrical technicians.

Agreement has been reached with the Ministry of Labour and National Service regarding the deferment of candidates qualifying under the new Examination Regulations.

Discussions have taken place with the British Institute of Management on the subject of management studies for electrical engineers. The purpose of these talks is to discover whether courses in management studies already available are meeting the needs of the electrical engineering industry or if the Institute can assist in providing suitable courses.

The provision of equipment for colleges in Colonial territories has been discussed with the Advisory Committee on Colonial Colleges of Arts, Science and Technology. There is considerable need in these colleges for adequate equipment to enable them to offer satisfactory courses in engineering, and the Committee consider that it is extremely important that this equipment should be supplied from the United Kingdom.

A Report on the Recruitment of Scientists and Engineers by the Engineering Industry which was published in Sep-

tember, 1955, by the Advisory Council on Scientific Policy, was the subject of a discussion at an Ordinary Meeting of The Institution in March, 1956. The Report was welcomed as an indication of agreement with the educational policy which has been advocated by The Institution for some years. Discussions were also held with members of the Committee on Scientific Manpower on the future needs of the industry; appreciation was expressed by them of the efforts which The Institution is making to encourage recruitment to the electrical engineering profession.

The Committee welcomed the establishment of the Industrial Fund for the Advancement of Scientific Education in Schools which will encourage the provision of better facilities and increase interest in the study of Science subjects, to the ultimate benefit of the industry through a larger proportion of boys and girls taking up careers in science or technology.

59 Technological Education

There has been a significant advance in the plans for technological education during the past year. In July, 1955, the Minister of Education announced in general terms the Government's policy for the extension of facilities in universities and technical colleges for the education of a greatly increased number of technologists. Based on the recommendations of the National Advisory Council on Education for Industry and Commerce, an autonomous body, the National Council for Technological Awards, was being constituted under the Chairmanship of Lord Hives, C.H., M.B.E., D.SC., LL.D. It would be responsible for the administration of a new award in technology of status equivalent to a university degree, and possibly for other awards at a later date.

Under the constitution of the Council, there is one Board of Studies in Engineering and another for Technologies other than Engineering. Mr. S. E. Goodall, M.SC.(ENG.), VICE-PRESIDENT, and Mr. G. S. C. Lucas, O.B.E., MEMBER, have been nominated by the Council to serve on the Board of Studies in Engineering. The views of The Institution will also be heard through other Vice-Presidents and members who have been nominated by the Minister and the Teachers' Associations to the Council and to the Boards of Studies. The Executive Committee of the Council and the Boards of Studies have held a number of meetings, but no statement has yet been issued.

At the end of February, 1956, a White Paper was presented to Parliament by the Minister of Education and the Secretary of State for Scotland on Technical Education. These proposals provide for a substantial increase in capital expenditure on colleges and equipment and the building up of a number of colleges for the teaching of advanced technology. These proposals aim at increasing by one half the number of students following advanced courses in technical colleges and seek to encourage employers to release twice as many students to attend part-time day classes.

60 Joint Advisory Committee on Education

During the year the Joint Advisory Committee on Education (J.A.C.E.), representing the three major Engineering Institutions, have again been deeply concerned with the subject of technological education. Representatives of J.A.C.E. have had meetings with the Minister of Education, the Chairman of the new National Council for Technological Awards, Lord Hives, and the Chairman of the National Advisory Council on Education for Industry and Commerce (N.A.C.), Sir Ronald Weeks, K.C.B., C.B.E., D.S.O., M.C., T.D., as well as the Education Committee of the Parliamentary and Scientific Committee.

In July, 1955, the Minister announced that he proposed to implement the scheme recommended by the N.A.C., by the establishment of a Council for Technological Awards (see par. 59). As a result of the Minister's statement, a letter from the Presidents of the three Institutions was published in *The Times* outlining their policy, which had already been communicated to the Minister. Since that date the Committee have been kept fully informed of the activities of the National Council for Technological Awards through their representatives.

After the second EUSEC Conference in September, 1954, the J.A.C.E. has been co-ordinating the replies of the three Institutions to questionaries dealing with School Types and Criteria for Professional Recognition, and our representatives have acted as rapporteurs for questionaries dealing with General Education and Education at Engineering Schools of University Level.

61 'The Inquiring Mind'

The Institution's new film *The Inquiring Mind* referred to in the Report for 1954–55 was completed in nine months from its inception and was first shown in June, 1955. The Council received generous support from numerous organizations both towards the cost and by the provision of facilities and film material. The film has been circulating among public schools and grammar schools since the beginning of the autumn term and so far there have been more than 160 presentations in various parts of the country. There have also been more than 100 performances of the film for other interested viewers and copies have been made available to the Council's Oversea Representatives in Australia, New Zealand, Africa and Canada.

Whenever the film is shown in a school an offer is made for a senior member to be present and to speak generally on electrical engineering as a career and to answer questions. The Council attach a great deal of importance to the follow-up value of The Institution representative and to the careers booklet 'The Chartered Electrical Engineer' and they are grateful to all those members who have so willingly compered the film in schools.

The film received an excellent reception by the Press following its première in June, 1955, in the Lecture Theatre of The Institution. The film was included in a B.B.C. television programme in August, 1955, and it was also chosen for presentation at the Edinburgh Festival, at the Meeting of the British Association and at the Radio Show.

The film is directed primarily to senior boys in public and grammar schools, particularly those who may not have realized the opportunities offered by engineering as a career. The theme of the film is inspirational rather than informative, seeking to give a broad picture of the fields in which electrical engineers are engaged. The early part includes glimpses of the education and training of a boy who moves from the classical side at school to take up a career in electrical engineering. The vast field which the industry covers is then conveyed by scenes of engineers at work in numerous sections of the industry and the film ends with some speculating on future developments, where the speaker is seen in the Lecture Theatre of The Institution.

62 Careers Exhibitions

As part of the Council's policy of encouraging more boys and girls, particularly those from grammar and public schools,

to look to electrical engineering as a career, support has been given at a number of careers meetings and careers exhibitions. An electrical engineering stand has been prepared for use at these exhibitions. It depicts the diverse opportunities for a career, the schemes of education and practical training which are available, with particular reference to the life and work of an apprentice, and information about courses provided by universities and technical colleges. The exhibit is generally supplemented by working models and the Council express their appreciation of the assistance given by industry in providing exhibits for this purpose.

Experience indicates that these exhibitions provide an excellent opportunity to promote an interest in careers in electrical engineering, particularly in areas which are mainly rural in character. This was particularly noticed at a careers exhibition organized by the Ramsgate Rotary Club in April, 1955, when many enquiries were made about apprenticeships and hostel facilities in the electrical engineering industry. Preparations are in hand in connection with two careers exhibitions to be held during the Easter holidays.

63 Examinations

The Examinations Committee have met each month during the session and continued to implement the Institution Examination Regulations that were published in September, 1954, and become fully operative in October, 1956. This involves a reassessment of all qualifications considered for exemption from any part of the Institution Examination.

In 1955 the Council approved an alternative path to Associate Membership for graduates in natural sciences and mathematics. They have now agreed that graduates in engineering sciences, who have gained a degree awarded principally in a branch of engineering other than electrical engineering, shall be allowed to qualify in the same way. Thus if the training and responsible experience of these candidates shows that they have been able successfully to apply their education to the problems of electrical engineering, they may at this stage be granted exemption from certain subjects of the Institution Examination for which at an earlier stage they would have been required to sit.

Further home and oversea degree and diploma courses have been considered for exemption from the appropriate sections of the Institution Examination. Some Army Examinations, The Limited Competition for Appointment as Executive Engineer in the General Post Office and many National Certificate courses have also been considered for exemption. It is intended to publish, in the near future, a revised edition of the Schedule of Accepted Educational Qualifications, incorporating the decisions given under the new Examination Regulations.

A list of exempting qualifications produced by the Engineering Institutions' Standing Committee for Part I has been approved.

A List of Books suitable for the Institution Examination has been issued and the Laboratory Syllabus for the Institution Examination has been revised to include experiments for Part III of the Examination, and will shortly be re-issued.

The Council have also approved a recommendation that Student membership may be extended beyond the age of 28 if a candidate is likely to complete the educational requirements for Graduate membership within a reasonable period. Hitherto this concession has been granted only to a candidate whose studies had been interrupted as a result of the war.

64 The Institution Examination

During 1955 The Institution of Municipal Engineers and The Institute of Marine Engineers joined the Engineering Institutions' Examination Part I Committee, the former Institution being granted permanent representation. An application from a third Institution for representation on the Committee was received and is at present under consideration. It was decided to introduce Engineering Drawing as a new compulsory subject for electrical engineering candidates in the examination from April, 1957.

The Councils of the Institutions have long been aware that the professional engineer must possess a sound knowledge of the English language, and for many years an English paper has been included in the Institution Examination and in the examinations of the other major engineering Institutions. At the end of the war arrangements were made for the Joint Section A (now Part I) Examination in English to be held at technical colleges for the benefit of National Certificate students. The examination has done much to raise the standard of English among engineering students, the majority of whom are destined to become technicians in industry, but the Councils of the engineering Institutions feel the time has come to inquire whether the paper is of the standard required of a professional engineer. The Engineering Institutions' Standing Committee for Part I has, therefore, set up a Panel to investigate this question, and their Report will be presented during 1956. It is worth noting here that in 1955 the Committee approved, for exemption from English in Part I, a pass in the General Certificate of Education at (0) Level in English Language, and strongly recommended that students should obtain this certificate or an equivalent qualification elsewhere before commencing their engineering studies.

The Institution Examination was held in April and October for candidates in the British Isles, in April for oversea candidates in the Northern Hemisphere and in October for oversea candidates in the Southern Hemisphere. Those oversea candidates, however, of the Northern Hemisphere who were still permitted to take Section B under the old Regulations, were allowed to defer their examination from April until October. The new Part II Examination was held for the first time in April, 1955, Part III will be introduced in April, 1956, and Section B will be held for the last time on that occasion. The following table shows the number of candidates for the various parts of the examination.

	April, 1955		*October, 1955*	
	Number of centres	Number of candidates	Number of centres	Number of candidates
Home Centres (including the Republic of Ireland)				
Part I	16	155	19	121
Part II	4	9	4	10
Section B	11	145	8	129
Technical Colleges (English only)	190	5455	50	550
Oversea Centres				
Part I	22	280	21	51
Part II	8	46	4	9
Section B	19	137	40	227
H.M. Forces	5	5	1	1

The figures for the Part I Examination include only those candidates seeking membership of The Institution.

65 Theses

During the 1955–56 session four candidates have submitted theses all of which have been accepted. The corresponding figures for the previous year were ten theses submitted of which seven were accepted.

66 Common Preliminary Examination

The purpose of the Common Preliminary Examination is to set a minimum standard of general education to be reached by all candidates for Student membership. The majority of candidates possess a School Certificate, a General Certificate of Education or some other qualification accepted for exemption from the Common Preliminary Examination, but a small number are required to take it.

The examination is administered by the Engineering Joint Examination Board, on which the principal Engineering Institutions are represented. It is held twice yearly, in April and October, both at home and abroad. During the year under review 36 candidates for membership of The Institution were examined at home and 116 abroad, compared with 44 and 103, respectively, in 1954.

67 National Certificates and Diplomas in Electrical Engineering

In the conduct of courses in Electrical Engineering and the award of National Certificates and Diplomas, The Institution has been associated with the Ministry of Education (England and Wales), the Scottish Education Department and the Ministry of Education (Northern Ireland).

Some information about the courses provided and the qualifications awarded are given in the following tables:

TABLE I

	Number of courses	
	1954	1955
England and Wales	670	721
Scotland	48	51
Northern Ireland	14	14
Total	732	786

TABLE II

National Certificates Awarded

	O.N.C.		H.N.C.	
	1954	1955	1954	1955
England and Wales ..	2833	3226	1950	2036
Scotland..	192	166	98	104
Northern Ireland ..	36	22	22	24
Total	3061	3414	2070	2164

TABLE III

National Diplomas Awarded

	O.N.D.		H.N.D.	
	1954	1955	1954	1955
England and Wales ..	42	42	86	75
Scotland..	—	—	20	13
Total	42	42	106	88

These tables illustrate the continued growth of the National Certificate Scheme, though the rate of increase is slowing up and it is possible that the number of students qualifying for National Certificates may begin to decline. Two factors will contribute to this. The new City and Guilds' examinations for electrical technicians will be in operation from the session 1956–57 and more suitable courses will be provided for many students who at present find the National Certificate courses unduly difficult. It is also likely that an increasing number of student apprentices will obtain their professional educational qualifications by means of sandwich courses instead of by the National Certificate route.

The Ordinary National Certificate course will continue to provide a sound technical education for a large number of students for whom the alternative courses may not be wholly appropriate, while the Higher National Certificate will be an appropriate qualification for many senior technicians who wish to qualify for posts of responsibility. Exemption from the Institution Examination through National Certificate courses will continue, but it is expected that these courses will be followed by a decreasing number of those students who hope to obtain professional qualification.

68 Page Prize

The Page Prize, which takes the form of textbooks or instruments to the value of five guineas, is awarded each year to the candidate who is adjudged as having the best performance in the final examinations of the Higher National Certificate in Electrical Engineering. The Council decided that the 1955 award should be made to Mr. A. C. Mason, of Denbighshire Technical College, Wrexham.

69 Scholarships

The Scholarships Committee met twice during the year under review.

Eight candidates were interviewed for the Research Scholarships, two for the Graduate Scholarships and eleven for the Student Scholarships. The names of the successful applicants were published in the *Journal* (October, 1955). There was a small decrease in the number of nominations received for the Student Scholarships, but the number of applicants for the Research and Graduate Scholarships remained unchanged.

The projects of the Research Scholars continue to be varied and include work in the newer fields as well as the more traditional subjects, those for 1955 included an investigation of the band compression of picture signal wave-forms and an investigation of stray fields and losses in electrical rotating machines.

The Council have approved conditions applying to a new award, the Geipel Scholarship, which has been founded as a result of a bequest made by Mr. William Guy-Pell, MEMBER (deceased). The Scholarship has an annual value of £50 tenable for four years and is available for candidates wishing to prepare for a career in the electricity supply or electrical manufacturing industries.

Some minor changes have been made to the conditions of award of the Paul Scholarship for candidates who wish to hold professional and executive positions in the instrumentation field of the electrical engineering industry. The maximum value of the award has been increased to £150 per annum.

70 Education Discussion Circle

The Education Discussion Circle has now been in existence for nearly ten years, the first meeting having been held in

November, 1946. Since then nearly 80 informal meetings of teachers and others interested in the teaching of electrical engineering have taken place. In addition each session's programme has usually included an exhibition of laboratory equipment or visits to engineering firms. As part of the 1955 programme, visits were made in June to eight firms engaged in the manufacture of electrical instruments and allied equipment. The majority of these were well supported—though the railway strike reduced the attendance at two of the visits—and they were greatly appreciated by those who took part. The main programme consisted of eight meetings, one of which was held at the Science Museum, South Kensington, when the Senior Keeper spoke on the Electrical Communications Collections and afterwards conducted a tour of the exhibits. There has been an average attendance of 45 members at the meetings held during the session.

Education Discussion Circles are also a regular part of the activities of the South Midland and North Midland Centres.

71 Joint Committee on Practical Training

The Joint Committee on Practical Training in the Electrical Engineering Industry have met twice during the year. There have also been seven meetings of Panels responsible for the preparation of particular sections of the new Report on the Practical Training of Professional Electrical Engineers. This Report dealing with Graduates has reached a final stage of drafting and it is hoped that it will be published during the coming year.

The Joint Committee have also undertaken the preparation of a complementary Report dealing with the Practical Training of Professional Electrical Engineers through Student apprenticeship with special reference to industry-based sandwich courses.

72 Courses for Electrical Technicians

A Conference on Courses for Electrical Technicians was held in the Lecture Theatre of The Institution on Friday, 2nd December, 1955. Nearly 250 persons were present, including a large number of principals of technical colleges and education and training officers in industry. The Ministry of Education, Regional Advisory Councils for Further Education, associations concerned with electrical technicians, and the Armed Forces were also represented.

This was the third conference to be convened by the Council since they first invited interested organizations, in 1953, to discuss the widespread need for more courses—recently underlined by the Government White Paper on Technical Education—to meet the requirements of the large number of technicians for whom the existing Craft courses and National Certificate courses were not suitable. After the second conference in July, 1954, an Interim Report was published by the Council, and the City and Guilds of London Institute then undertook to develop a scheme of examinations on the lines recommended in this Report. The City and Guilds of London Institute have prepared regulations and syllabuses for the conduct of examinations for electrical technicians and the main object of the recent Conference was to help publicize the scheme and to provide an opportunity for discussing its implementation. A short 'Report on Courses for Electrical Technicians' drawing attention to the new scheme and commenting upon some of the proposals has been published by the Council.

The new scheme is planned to offer Technicians' Certificates for electrical technicians engaged in the design, manufacture, testing, erection, operation and maintenance of electrical plant and equipment in a number of branches of electrical engineering. Initially the examinations will cover Plant and Machinery, Power Generation and Supply, and Industrial Electronics. Additional courses will be developed to meet other needs of the electrical engineering industry and at the request of the Council early attention is being given to a course for electrical drawing-office technicians.

The Electrical Technicians' Certificates will be endorsed by The Institution, the City and Guilds of London Institute and, when appropriate, an association concerned with technicians. The Full Technological Certificate will, in addition, be endorsed by the Ministry of Education.

Full particulars of the courses and examinations are published by the City and Guilds of London Institute in Regulations No. 57 entitled 'Electrical Technicians' Courses'.

73 Advisory Service on Education and Training

Most users of the Advisory Service are new entrants to the profession seeking information about the education and training required of the professional electrical engineer, though the facilities continue to be used by Student and Graduate members. In addition, the Service is available to Government Departments, and numerous enquiries are made by the Ministry of Labour and National Service and the Colonial Office. The Council are very appreciative of the help given by members of the Panel who are available when required to interview candidates experiencing special difficulties.

74 Technical Publications

The Technical Publications Panel have met twice during the year and as a result of their efforts a number of advanced textbooks are in course of preparation. Books published as a result of the activities of the Panel will be announced in the *Journal*.

75 Third EUSEC Conference on Engineering Education

The second EUSEC Conference on the Education and Training of Professional Engineers held in September, 1954, recommended that its work should be continued and that a third Conference should be arranged, preferably in the Autumn of 1956.

The three Institutions, through the Joint Advisory Committee on Education (see par. 60), are acting as general rapporteurs for two subjects, 'General Education before Admission to Engineering Schools of University Level' and 'Education at Engineering Schools of University Level'. Questionaries have been circulated to participating countries accordingly, although not all have yet been returned. Because of this situation, reported similarly by all rapporteurs, the proposed date for the Third Conference has been deferred until the Spring of 1957.

76 Reception for Oversea Graduates

There were nearly 200 people present, including 150 graduates from abroad, at the Reception for Oversea Graduates which was given by the President and members of the Council in September, 1955. The visitors included Athlone Fellows and F.B.I. Scholars and altogether 28 different countries were represented. The programme included tea in the Library, an address by the President, the film *The Inquiring*

Mind and a number of exhibits chosen chiefly to illustrate notable British contributions to electrical engineering.

77 Lectures for Young People

This year's Christmas Lecture was on the subject of 'Electric Traction' and was delivered on the afternoons of the 29th and 30th December, 1955, by Mr. R. Brooks, B.SC., MEMBER. The Lecture was very successful and was attended by about 500 schoolchildren on each day. At the invitation of the North-Western Centre Committee, the Lecture was repeated the following week in Manchester and Salford with equal success.

In addition, the Faraday Lecture by Mr. B. L. Metcalf, B.SC.(ENG.), MEMBER, on 'Coal Mining Electrically' was repeated in Nottingham with the support of the Local Education Authority.

78 Manchester College of Technology

In October, 1954, The Institution was invited by the Manchester City Council to be represented at a Conference to consider the future of Manchester College of Technology, for which it had been proposed that an independent governing body should be established. The Council of The Institution agreed in principle to this proposal, provided that the College was not to become an independent university of technology, the preferred course, in their opinion, being closer integration with the University of Manchester.

In September, 1955, the College received a Charter of Incorporation from the Queen, under the style and title of the Manchester College of Science and Technology. In response to an invitation to appoint a representative to serve on the Court of Governors of the new College, the Council nominated Dr. Willis Jackson, D.SC., DR.SC.TECH., F.R.S., VICE-PRESIDENT.

The new status of the College does not affect its function as the Faculty of Technology of the University of Manchester.

79 Technical Education in Russia

In November, 1955, following an invitation of the Soviet authorities made during the Geneva Conference (see par. 52), eight British scientists and engineers visited Moscow to inspect nuclear power developments in Russia. Dr. Willis Jackson, D.SC., DR.SC.TECH., F.R.S., VICE-PRESIDENT, a member of the party who had represented the three Engineering Institutions at Geneva, also visited the Moscow Higher Technical School of Mechanical Engineering (the Bauman Institute) and recorded his impressions of Russian technical education in an article in the *Journal* for February, 1956.

SECTION F Institution Library and Publications

80 Library

The main collection contains nearly 10000 books, over 11000 volumes of periodicals, reports, etc., and several thousand pamphlets. Over 500 current periodicals are being received.

The following statistics indicate the additions to the Library during the year, the use made of the Reference Library by members and non-members, and the extent of borrowing from the Lending Library. Figures for 1954 are shown for comparison.

Reference Library

Year	Additions to the Library				Readers	
	Books		Pamphlets			
	Presented	Bought	Presented	Bought	Members	Non-members
1954	90	189	1182	101	6631	604
1955	149	172	1094	104	7760	629

Lending Library

Year	Books added to the Lending Library	Books issued	Borrowers
1954	163	4412	1560
1955	154	5172	1904

In addition, full use has been made of the facilities of the Science Library and Lewis's Library; the Science Library Photocopy Service has been used on 624 occasions. Particulars of the latter service have been published in the *Journal* (January, 1956).

81 The *Journal* and *Proceedings* of The Institution

The numbers of members and non-members who subscribed for the *Journal* and the *Proceedings* in 1955 are given below.

	No. of pages		No. of members receiving copies		No. of non-member subscribers	
	1954	1955	1954	1955	1954	1955
Journal ..	332	786	All members		Not sold	1666
Proceedings:						
Part I ..	398	—	17939	—	1876	—
Part II ..	696	—	16535	—	1999	—
Part III..	416	—	9735	—	2439	—
Part IV..	304	—	1609	—	1164	—
	1814					
Part A ..	—	876	—	15831	—	1940
Part B ..	—	872	—	11309	—	2494
Part C ..	—	296	—	6730	—	1568
		2044				

Figures for the previous year are also given for record purposes, but direct comparison is hardly possible, except in the case of Part IV and Part C (Monographs), the one being a continuation of the other. The larger circulation of Part C is no doubt due to the fact that it is published regularly twice a year, whereas Part IV appeared only at irregular intervals.

The principles governing the allocation to Parts A and B of material which formerly would have appeared in Parts I, II and III were explained in the last Report. The new arrangement has met with wide approval, although a few members have suggested that one or two papers published in Part B would have been more appropriately placed in Part A, and vice versa. Had this been done, it might not have satisfied all of those who subscribed for only one of these Parts: publication in both Parts of these border-line papers might, conceivably,

be possible in the future, but cannot be contemplated at present. Indeed, with the ever-growing volume of material accepted for publication—all of which has to pass the most stringent tests—it has been necessary to reduce the maximum permissible length of a paper from 12 pages of the *Proceedings* to 10 pages; to limit the reports of contributions to discussions to 300 words; and to discontinue the publication of digests of monographs in Parts A and B of the *Proceedings*.

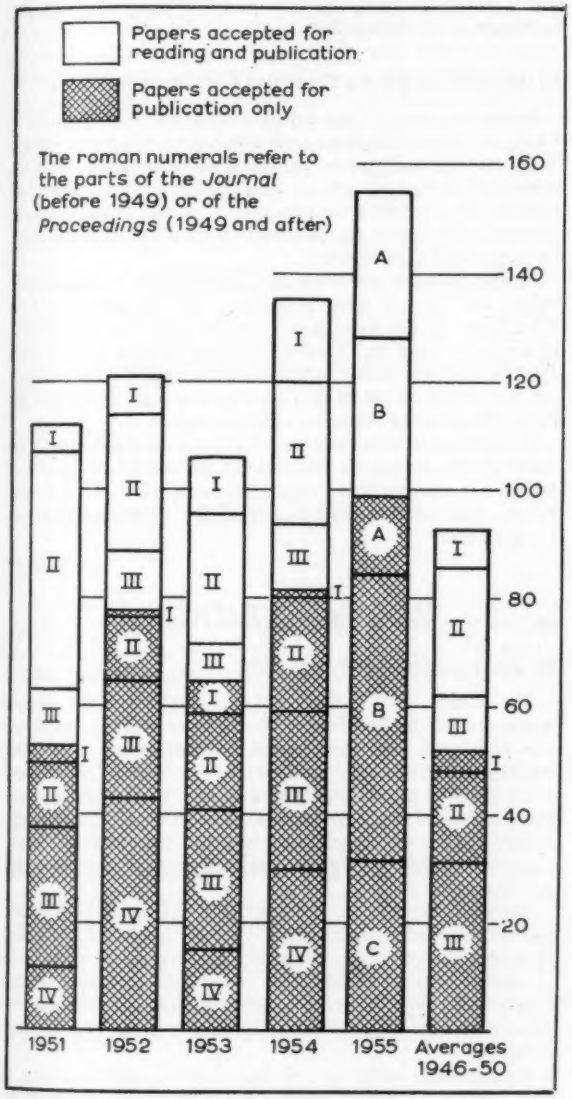

Fig. 4 *Numbers of papers published*

NOTES

1. 1951—Of the 44 papers accepted for reading and published in Part II, 7 were read at the Symposium on Radiation Monitoring Apparatus; 7 at the Symposium on Electrical Meteorological Instruments; and 10 at the Conference on Electrical Instrument Design. Of the 12 papers accepted for reading and published in Part III, 3 were read at the Symposium on the Sutton Coldfield Television Station.
2. 1952—Of the 11 papers accepted for reading and published in Part III, 3 were read at the Symposium on Microwave Links.
3. 1953—Of the 10 papers accepted for reading and published in Part I, 3 were read at the Symposium on Nuclear Reactor Instrumentation. Of the 24 papers accepted for reading and published in Part II, 4 were read at the Symposium on Digital Computers.

The numbers of papers published in the *Proceedings* during the five years 1951–55, and the average numbers for 1946–50, are shown graphically in Fig. 4. Addresses, lectures, progress reviews and reports are not included, nor are the papers which were published in special issues of the *Proceedings*, particulars of which were given in earlier Reports.

The *Journal*, in its new style, has continued to meet with approval from members. Five Electrical Engineering Reviews, 40 special articles and 26 letters have been published in 1955–56. The treatment in the *Journal* of papers published in the *Proceedings* was altered in January, 1956, the 'Digests' being replaced by 'Short Reviews', which are intended to discuss the subject-matter of Institution papers in a manner readable by the non-specialist, some of the more specialized papers being now only briefly summarized in the *Journal*. Recently a renewed effort has been made to obtain more information about Institution and allied activities overseas, and the Council hope that there will in future be a better coverage of them in 'News from Abroad'. The typography, paper and layout of the *Journal* are continually under review, and a few significant changes were made at the beginning of 1956. At that time also the background colour of the cover was changed to blue and a slight alteration made in its design; many members appear to prefer the new appearance to the old. In February, 1956, a single page of four-colour half-tone blocks was used for the first time, to illustrate an article on colour-television, but expense precludes more than an occasional use of colour. Indeed the cost of producing the *Journal* has been mounting steadily, and the Council are aiming to obtain a greater advertisement revenue to set against this increased cost. The average number of advertisement pages in an issue of the *Journal* has risen a little during the year, though not as much as was originally hoped for. The Council stress that the new style of the *Journal* should still be regarded as experimental, and they may at times introduce further changes in it to meet the needs and the wishes of members.

Paper, Reprint and Monograph Services.—A paper accepted for reading at a meeting, like a monograph, is first published individually and republished in the *Proceedings* later. Reprints from the *Proceedings* of such papers, together with the discussions, and of papers accepted for publication only, are also published. Particulars of the paper, reprint and monograph services are given each month in the *Journal*, and also in the form of a leaflet which is distributed to non-members who subscribe for the *Proceedings* but not for the *Journal*.

82 Reviews of Progress

The following progress reviews were published in the *Proceedings* during the period covered by the Report:

The Utilization of Electricity in Ships [Paper No. 1868, August, 1955 (**102** A, p. 429)].
Ferromagnetism in relation to Engineering Magnetic Materials [Paper No. 1947, February, 1956 (**103** A, p. 39)].
Power Stations and their Equipment [Paper No. 1954, April, 1956 (**103** A, p. 169)].

Reviews on 'Switchgear' and 'Electric Traction' will be published shortly.

83 *Students' Quarterly Journal*

The *Students' Quarterly Journal* has been maintained at its size of 64 pages and continues to be widely read and enjoyed. It is hoped that with the new volume starting in September, 1956, it will be possible to improve the quality of paper and the typography.

The June, 1955, issue was the centennial number, completing 25 years of continuous quarterly publication.

84 Premiums

The Premiums awarded by the Council for papers read at meetings, or accepted for publication only, will be announced in the *Journal* during the summer.

The Council have accepted a proposal from the Southern Electricity Board to endow, as a memorial to the late Mr. Henry Nimmo, C.B.E., MEMBER, a Premium for members of Graduate and Student Sections to be known as "The Henry Nimmo Premium'. The value of the Premium, which will be an annual award, will be £10 and it will be given for the best paper on a subject coming within the field of electricity supply read before a Graduate and Student Section.

85 *Science Abstracts*

The size of each Section of *Science Abstracts* was maintained in 1955 at approximately the same level as 1954, Section A (Physics) containing 10160 abstracts compared with 11693 in 1954, and Section B (Electrical Engineering) containing 5403 abstracts compared with 5402.

An important innovation took place in January, 1956; *Science Abstracts* will henceforward be produced by typewriter composition and photolithographic reproduction ('pro-printing'). By this means it is hoped to save both time and money in the publication of the monthly issues.

The progress of the cumulative 5-year index (which is also being produced by 'pro-printing') was unfortunately retarded by late delivery of electric typewriters, and the demands arising from the introduction of the new methods into the publication of the regular issues of *Science Abstracts* have inevitably led to a further setback. More than half of it has been prepared for press, however, and the preparation of the remainder is continuing.

86 Regulations for the Electrical Equipment of Buildings

The 13th Edition of the Regulations, superseding all previous editions and supplements thereto, was promulgated on 1st September, 1955, and was subsequently approved for the purposes of the Electricity Supply Regulations, 1937, on behalf of the Ministry of Fuel and Power and the Secretary of State for Scotland. Over 40000 copies of the new edition have been sold.

The Abridged version of the Regulations, issued in 1951 and based on the 12th Edition, was withdrawn, and the question of any reissue is being deferred until its probable usefulness can be assessed more closely in the light of experience with the 13th Edition, which is more concise than its forerunner.

The Recommended Practice for Electrical Installations in Caravans, based on the Regulations and issued in 1954, has remained current, as it is largely self-contained, and a 2nd Edition which will bring it fully into line with the 13th Edition has been approved for promulgation.

Liaison continues to be maintained with the British Standards Institution regarding British Standards cited in the Regulations, and a number of important draft Standards have been scrutinized from the aspect of safety from fire and shock. Particular study has been given during the year to the technique of double insulation.

87 Regulations for the Electrical Equipment of Ships

Acting on behalf of the British National Committee of the I.E.C. as United Kingdom Committee for liaison with I.E.C. Technical Committee No. 18, the Committee have virtually completed their work for an I.E.C. Code of Recommended Practice for Electrical Installations in Ships, which is likely shortly to go before the National Committees of the I.E.C. for approval for publication.

As the international work has now reached a satisfactory stage, the Council have authorized the preparation of a 4th Edition of the Regulations for the Electrical Equipment of Ships, to take the place of the 3rd Edition (1939) with 1947 Supplement. Sub-Committees have been set up to carry out the detailed work of preparation, and their drafts will go before the parent Committee in due course.

In addition to other relevant publications, account will be taken of the comments received on the revised 3rd Edition and of the matters noted during previous work of the Committee, particularly in the course of the studies carried out for the I.E.C.

SECTION G Benevolent Activities

88 Incorporated Benevolent Fund

The Report of the Court of Governors for the twelve months ended the 30th June, 1955, together with the Accounts, was circulated with the *Journal* for September, 1955; the report was subsequently published in the *Journal* (November, 1955, p. 687). Subscriptions and donations showed a small increase from £12427 to £12854. This amount is insufficient, however, to cover expenditure and the Court appeal most urgently for help from those members who at present make no contribution.

The standard of grants has been maintained and expenditure has shown a small decrease, due to the non-recurrence this year of some exceptional expenses concerning the expansion of 'The Chesters' Estate. The cost of maintenance of the Estate will now tend to rise, although this will be offset to some extent by the reduction of grants to those who become residents.

Grants were made to 133 beneficiaries, and in assisting these persons the Fund also gave support to 111 of their dependants. The total amount of these grants was £9092, the average amount distributed per beneficiary during the year being approximately £68.

The Fund now has five beneficiaries resident in the Crossways Trust homes at West Worthing, Brighton, and the home for the infirm at Englefield Green, to which a further unit of £1000 has been subscribed, thus enabling the Fund to nominate one resident more than last year.

The tenants on 'The Chesters' Estate form a very happy and contented little community, though each home keeps its individuality on this pleasantly situated estate.

The total amount received in subscriptions and donations since the inception of the Homes Fund to the 30th June, 1955,

was £35 531, and in addition 225 members have signed Deeds of Covenant for the payment of subscriptions for a period of seven years.

The Accounts of the Wilde Fund were published in the *Journal* (July, 1955, p. 441).

Lord Hirst Fund.—This Fund exists for the purpose of giving financial assistance to persons who apply for help from the Benevolent Fund and are recommended to the Trustees by the Court of Governors of the Benevolent Fund as persons who in their opinion have rendered important services to Electrical Science, Electrical Industry or Electrical Engineering (whether such persons are or have been members of The Institution or not), or to the dependants of such persons.

On the 30th June, 1955, the Fund comprised:

Capital Account investments	£11 543 3s. 10d.
Income Account investments	£3 196 19s. 2d.

which produce an annual income of about £427. The uninvested balance of the Income Account was £180 5s. 4d.

Grants of £230 were sanctioned by this Fund during the year.

SECTION H

Institution Staff

89 The Staff

The Council express their warmest thanks to the Secretary and his staff for their work during the past year in support of The Institution's wide programme of activities. The traditionally high standards of their service have been fully maintained.

APPENDIX A

Membership of The Institution

The changes in the membership, since 1st April, 1955, are shown in the following table:

	Hon. Mem.	Mem.	Assoc. Mem.	Com.	Assoc.	Grad.	Stud.	Totals
Totals at 1st April, 1955 ..	14	3 748	16 593	79	2 718	11 153	4 993	39 298
Additions during the year:								
Elected	1	5	175	3	78	897	819	1 978
Reinstated ..	—	1	11	—	1	21	25	59
Transferred to ..	—	173	810	—	2	689	—	1 674
Totals ..	1	179	996	3	81	1 607	844	3 711
Deductions during the year:								
Deceased ..	—	82	115	4	18	14	8	241
Resigned ..	—	1	25	1	19	52	70	168
Lapsed	—	2	44	—	49	138	655	888
Transferred from	—	—	173	—	25	759	717	1 674
Totals ..	—	85	357	5	111	963	1 450	2 971
Net change ..	+1	+94	+639	−2	−30	+644	−606	+740
Totals at 1st April, 1956 ..	15	3 842	17 232	77	2 688	11 797	4 387	40 038

APPENDIX B

Growth of Membership over the last fifteen years

Year (31st March)	Corporate Members	Non-Corporate Members	Total Membership	Annual Increase
1942 ..	10 483	10 567	21 050	775
1943 ..	11 097	11 218	22 315	1 265
1944 ..	11 924	12 634	24 558	2 243
1945 ..	12 573	14 091	25 665	2 107
1946 ..	13 447	15 711	29 158	2 493
1947 ..	14 501	16 759	31 260	2 102
1948 ..	15 206	17 701	32 907	1 647
1949 ..	16 027	18 344	34 371	1 464
1950 ..	16 648	18 900	35 548	1 177
1951 ..	17 146	19 412	36 558	1 010
1952 ..	17 757	19 496	37 253	695
1953 ..	18 510	19 272	37 782	529
1954 ..	19 552	18 944	38 496	714
1955 ..	20 355	18 943	39 298	802
1956 ..	21 089	18 949	40 038	740

APPENDIX C

Meetings

The following is a list of the meetings held during the 12 months ending 31st March, 1956:

General Meetings		
Ordinary Meetings ..	8	
Joint Meetings	4	
Annual General Meeting	1	
Annual General Meeting (Incorporated Benevolent Fund)	1	
Special General Meetings	2	
Extra Meetings	2	
Measurement and Control Section	15	
Radio and Telecommunication Section ..	15	
Supply Section	9	
Utilization Section ..	8	
Informal Meetings ..	7	
Education Discussion Circle	7	
Special Lecture	1	
District Meetings ..	20	
*Local Centres		
East Midland ..	15	(3)
Cambridge Radio and Telecommunication Group ..	6	(4)
Mersey and North Wales	19	(8)
North-Eastern ..	21	(10)
Radio and Measurement Group ..	12	(4)
North Midland ..	13	(9)
Utilization Group	6	(7)
North-Western ..	9	(8)
Measurement and Control Group ..	5	(5)
Radio and Telecommunication Group	5	(5)
Supply Group ..	5	(6)
Utilization Group	5	(6)
Northern Ireland ..	9	(6)
Scottish	7	(6)
South Midland ..	17	(6)
Radio and Telecommunication Group	6	(7)
Supply and Utilization Group ..	6	(6)
	266	(106)

Council and Committee Meetings	
Council Meetings	10
London Committees	
Courses for Technicians ..	1
Education and Training (and Sub-Committees and Panels)	21
Electrical Exhibitions ..	2
Examinations (and Sub-Committees and Panels)	18
Finance	7
General Purposes (and Sub-Committees and Panels)	13
Hon. Secretaries' Conference:	
Local Centres and Sub-Centres	1
Graduate and Student Sections	1
Incorporated Benevolent Fund (and Sub-Committees)	12
Industrial Process Heating ..	2
Informal Meetings	3
Joint Advisory Committee on Education	1
Joint Committee on Model Forms of General Conditions of Contract (and Sub-Committees and Panels) ..	14
Joint Committee on Practical Training in the Electrical Engineering Industry (and Panels)	12
Joint Oversea Activities ..	1
Joint Part I Examination ..	12
Library and Museum ..	1
Local Centres	2
Measurement and Control Section (and Sub-Committees)	36
Membership	11
National Certificates	
England and Wales (and Sub-Committees) ..	3
Northern Ireland	1
Scotland	1
Oversea Activities	2
	188

[*Continued on p. 398*]

APPENDIX C—*continued*

General Meetings	266	(106)
Local Centres—(contd.)		
Southern	24	(7)
Western	12	(8)
Supply Group	4	(3)
Utilization Group	6	(2)
*Local Sub-Centres		
East Anglian	11	(6)
North Lancashire	12	(8)
North Scotland	17	(6)
North Staffordshire	11	(8)
Rugby	11	(6)
Sheffield	9	(7)
South-East Scotland	12	(6)
South-West Scotland	12	(7)
South-Western	7	(5)
Tees-Side	7	(7)
West Wales (Swansea)	9	(9)
*Graduate and Student Sections		
Bristol	10	(5)
Cardiff	8	(6)
East Midland	10	(6)
London	20	(8)
Mersey and North Wales	10	(11)
North-Eastern	20	(8)
North Midland	10	(7)
	518	(252)

Council and Committee Meetings	188
Papers (and Sub-Committees and Panels)	18
Radio Equipment for Civil Aircraft	4
Radio and Telecommunication Section (and Sub-Committees and Panels)	60
Regulations for the Electrical Equipment of Aircraft	1
Regulations for the Electrical Equipment of Ships (and Sub-Committees)	4
Scholarships (and Panels)	3
Science Abstracts	3
Supply Section (and Sub-Committees)	12
Utilization Section (and Sub-Committees)	23
Wiring Regulations (and Sub-Committees)	5
Other London Committees	8
Centres, Sub-Centres and Graduate and Student Section Committees (see details in parentheses in left-hand column)	320
	649

General Meetings	518	(252)
Graduate and Student Sections—(contd.)		
North Scotland	6	(3)
North Staffordshire	9	(10)
North-Western	11	(7)
Northern Ireland	6	(6)
Rugby	10	(8)
Sheffield	10	(9)
Southern	10	(5)
South-East Scotland	9	(6)
South Midland	14	(9)
South-West Scotland	7	(5)
	610	(320)

Also Code Drafting Committees convened for the Council for Codes of Practice	11
General Meetings	610
Council and Committees	649
Codes of Practice	11
Grand Total	1 270

• The number of Committee meetings held are shown in each case in parentheses, and the total number of these Committee meetings is entered at the foot of the right-hand column.

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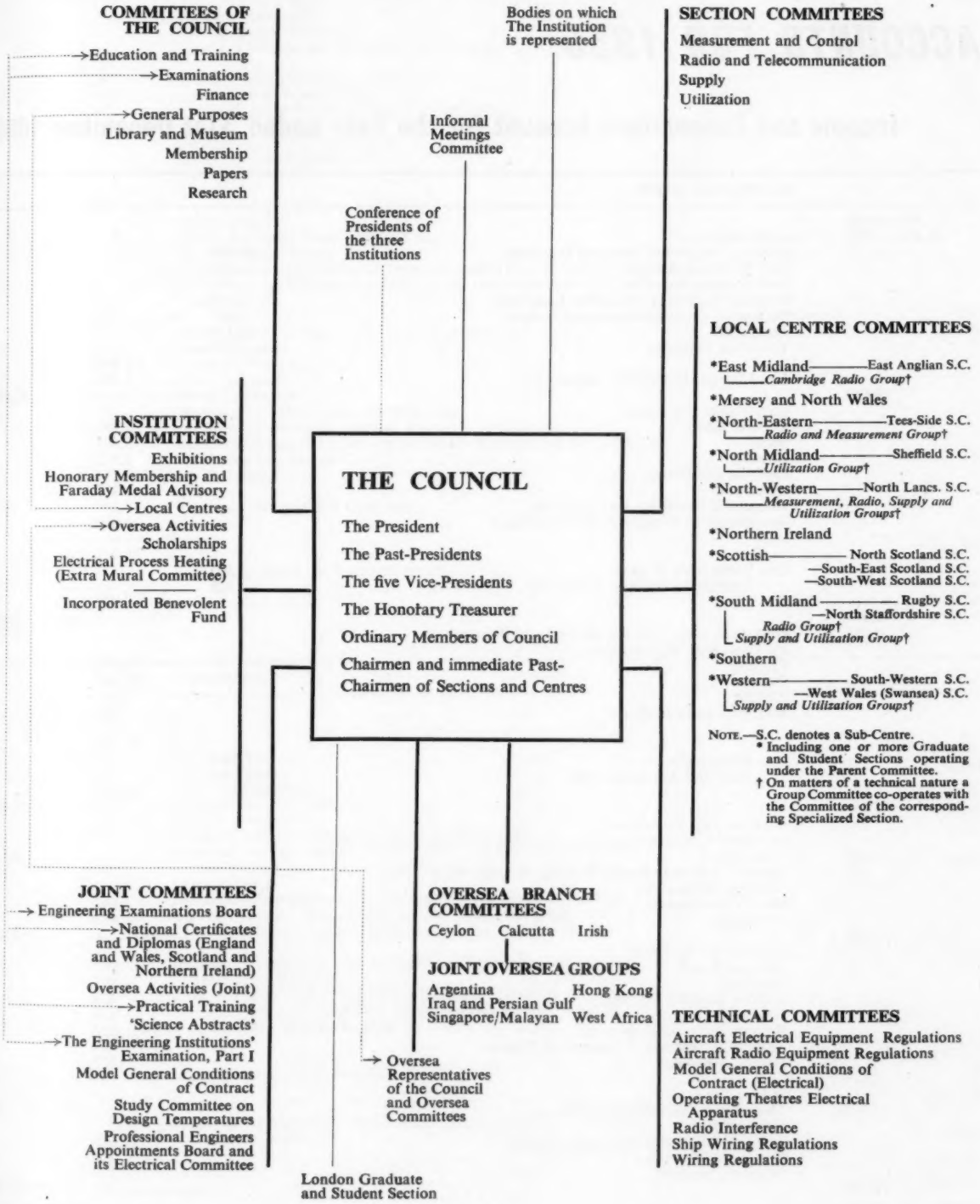
APPENDIX D The Organization and Government of The Institution



NOTE.—S.C. denotes a Sub-Centre.
* Including one or more Graduate and Student Sections operating under the Parent Committee.
† On matters of a technical nature a Group Committee co-operates with the Committee of the corresponding Specialized Section.

ACCOUNTS FOR 1955

Income and Expenditure Account for the Year ended 31st December 1955

EXPENDITURE

Year ended 31 Dec., 1954		£	£	£
£	MANAGEMENT:			
	Salaries, Wages and National Insurance	69,808		
	Staff Provident Scheme	5,639		
	Staff Canteen Subsidies	579		
	Printing, Stationery and Office Requisites	8,135		
	Postage of Correspondence and Notices	3,047		
	Telephone	1,125		
	Travelling Expenses	3,500		
			91,833	
	Less Charged to 'SCIENCE ABSTRACTS'		3,134	
79,652				88,699
	INSTITUTION BUILDING:			
	Ground Rent		2,201	
	Rates		5,495	
	Heating		3,032	
	Lighting and Power		762	
	Insurance		483	
	Household Requisites and Cleaning		3,268	
	Transferred to Repairs Suspense Account		4,000	
			19,241	
	Less Rents from Tenants	7,103		
	Charged to 'SCIENCE ABSTRACTS'	626		
			7,729	
13,333				11,512
2,168	FURNITURE AND FITTINGS (Repair and Renewals)			2,477
	JOURNAL AND PROCEEDINGS:			
	Printing		35,052	
	Paper		24,621	
	Postage		9,266	
	Wrappers and Envelopes		859	
			69,798	
	Less Subscriptions	13,462		
	Sales and Advertisements	27,434		
			40,896	
13,669				28,902
595	JOURNAL TEN YEAR INDEX			—
	STUDENTS' QUARTERLY JOURNAL (Editing, Printing, Postage, etc.:			
2,138	*less* Sales)			2,322
378	LENDING LIBRARY (Books, Printing, Postage, etc.)			344
	'SCIENCE ABSTRACTS':			
	Block Contribution		2,663	
	Per Capita		1,436	
4,068				4,099
	INSTITUTION MEETINGS:			
	Advance Proofs		997	
	Reporting		547	
	London Students' Section		429	
	Kelvin and Section Lectures		171	
	Refreshments, Assistance, etc.		922	
	Travelling Expenses of Authors of Papers		119	
	District Meetings		172	
3,616				3,357
	CONVENTIONS:			
193	Thermionic Valve Jubilee—Volume			611
	LOCAL CENTRES:			
	Administration and Meetings Expenses		12,860	
	Travelling Expenses		330	
	Students' Lectures		179	
12,185				13,369
131,995			CARRIED FORWARD	155,692

EXPENDITURE—*contd.*

£		£	£
131,995	BROUGHT FORWARD		155,692
	OVERSEA BRANCHES:		
	Administration Expenses	1,714	
	Loss on Exchange on remittances to London	499	
2,124			2,213
1,344	FARADAY AND CHILDREN'S LECTURES		1,667
460	PREMIUMS FOR PAPERS, ETC.		444
1,458	SCHOLARSHIPS, provided from Institution Funds		1,470
	GRANTS:		
	Electrical Research Association	500	
	British Standards Institution	250	
	C.I.G.R.É.	75	
	Others	126	
935			951
	CONFERENCES:		
	British Electrical Power Convention	78	
	British Nuclear Energy Conference	354	
	Conference of Engineering Societies of Western Europe and U.S.A.	340	
	Conference of Engineering Societies of the Commonwealth in London	44	
1,431			816
—	CONTRIBUTION TO FILM 'THE INQUIRING MIND'		500
244	ANNUAL DINNER		323
360	AUDIT FEE		473
15	LEGAL EXPENSES		315
2,512	MISCELLANEOUS EXPENSES		3,371
7,481	TRANSFER TO REBUILDING RESERVE FUND		8,230
10,000	TRANSFER TO GENERAL RESERVE FUND		—
278	TRANSFER TO SINKING FUND (PREMIUMS for Redemption of Cost of Building and Lease)		278
	DEPRECIATION:		
	Library	579	
	Furniture, Fittings and Equipment	987	
1,481			1,566
162,118			178,309
1,455	BALANCE CARRIED TO BALANCE SHEET		—
£163,573			£178,309

INCOME

Year ended 31 Dec., 1954				
£		£	£	£
132,982	SUBSCRIPTIONS			138,891
5,136	ENTRANCE FEES			4,464
336	LIFE COMPOSITIONS			—
7,481	INTEREST ON INVESTMENTS			8,230
387	DEPOSIT INTEREST			456
1,871	MEMBERS' SUBSCRIPTIONS TO 'SCIENCE ABSTRACTS'			1,648
3,028	SALES OF 'MODEL GENERAL CONDITIONS', 'WIRING REGULATIONS', 'SHIP WIRING REGULATIONS' and 'HISTORY OF THE INSTITUTION'			8,802
	EXAMINATIONS:			
	Institution Examination (Candidates' Fees and Sale of Papers)	13,359		
	Less Examiners' Fees, Printing, etc. (but excluding cost of Administration and Overhead Expenses, approx. £8,251)	6,814		
			6,545	
	National Certificates and Diplomas (Candidates' and School Authorities' Fees)	10,743		
	Less Assessors' Fees, Stationery, Postage, Travelling Expenses, etc. (but excluding cost of Administration and Overhead Expenses, approx. £4,588)	6,551		
			4,192	
11,406				10,737
946	SALES OF CONVENTION PROCEEDINGS			715
163,573				173,943
—	EXCESS OF EXPENDITURE OVER INCOME TRANSFERRED TO GENERAL RESERVE FUND			4,366
£163,573				£178,309

Balance Sheet, 31st December 1955

	£	£
CREDITORS		47,594
SUBSCRIPTIONS, ETC., RECEIVED IN ADVANCE		12,168
REBUILDING RESERVE FUND:		
Balance at 1st January, 1955	205,737	
Add Transfer from Income and Expenditure Account	8,230	
Gain on Redemption of Securities	35	
		214,002
GENERAL RESERVE FUND:		
Balance at 1st January, 1955	20,000	
Less Excess of Expenditure over Income transferred	4,366	
		15,634
RESERVE FUND FOR DEPRECIATION OF INSTITUTION BUILDING AND LEASE, BEING SURRENDER VALUE OF SINKING FUND POLICIES		24,455
REPAIRS SUSPENSE ACCOUNT:		
Balance at 1st January, 1955	4,139	
Amount reserved in 1955	4,000	
	8,139	
Less Expenditure on Repairs in 1955	3,202	
		4,937
Surplus of Assets over Liabilities:—Balance at 1st January, 1955		78,313
		£397,103

	£	£
INSTITUTION BUILDINGS AND LEASE (at cost)		69,631
SINKING FUND (Surrender Values of Policies for Redemption of Cost of Building and Lease)		24,455
LIBRARY (exclusive of the Ronalds Library and Faraday Papers, which are held in trust, but inclusive of Thompson Library):		
As per last Balance Sheet	5,601	
Additions in 1955	1,189	
	6,790	
Less Depreciation at 10% (excluding Thompson Library)	579	
		6,211
FURNITURE, FITTINGS AND EQUIPMENT:		
As per last Balance Sheet	18,435	
Additions in 1955	1,850	
	20,285	
Less Depreciation	987	
		19,298
DEBTORS		17,276
INSURANCE PREMIUMS AND SUNDRY PAYMENTS IN ADVANCE		2,814
STOCKS OF STATIONERY AND PAPER		16,597
REBUILDING FUND. INVESTMENTS (at cost):		
British Government Securities	119,699	
British Municipal Securities	32,720	
Dominion and Colonial Government Securities	37,695	
Public Boards and Trade Facilities Stocks	9,798	
Debenture Stocks	14,090	
(*Market value 31st December, 1955*, £186,196)		214,002
GENERAL RESERVE FUND. INVESTMENTS (at cost):		
British Government Securities		15,634
(*Market value 31st December, 1955*, £13,836)		
GENERAL FUND INVESTMENTS. INVESTMENTS (at cost):		
British Government Securities		4,209
(*Market value 31st December, 1955*, £3,725)		
CASH IN HANDS OF LOCAL CENTRES ON 31ST DECEMBER, 1955		1,622
CASH IN HANDS OF OVERSEA BRANCHES ON 31ST DECEMBER, 1955		2,311
CASH IN HANDS OF SECRETARY		321
CASH AT BANK		2,722
		£397,103

FALMOUTH, *Honorary Treasurer.* W. K. BRASHER, *Secretary.*

Report of the Auditors to the Members of The Institution of Electrical Engineers

We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit. In our opinion proper books of account have been kept by The Institution so far as appears from our examination of those books. We have examined the above Balance Sheet and annexed Income and Expenditure account which are in agreement with the books of account. In our opinion and to the best of our information and according to the explanations given us the said accounts are properly drawn up and the Balance Sheet gives a true and fair view of the state of the Institution's affairs as at 31st December, 1955, and the Income and Expenditure account gives a true and fair view of the excess of Expenditure over Income for the year ended on that date.

21st March, 1956.

ALLEN, ATTFIELD & Co., *Chartered Accountants*, 24 Martin Lane, Cannon Street, E.C.4.

BLUMLEIN-BROWNE-WILLANS PREMIUM FUND

	£ s. d.		£ s. d.
Capital Account	700 0 0	Investment (at cost): £686 10s. 0d. British Electricity 4¼% Stock (1974–79)	700 0 0
	£700 0 0		£700 0 0

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Balance carried to Balance Sheet	58 7 0	By Balance (as per last Account)	29 3 6
		„ Interest received	29 3 6
	£58 7 0		£58 7 0

WILLIAM BEEDIE ESSON SCHOLARSHIP TRUST FUND

	£ s. d.		£ s. d.
Capital Account	2,808 12 6	Investments (at cost):	
		£1,755 15s. 6d. 3½% War Stock	1,853 2 6
		£200 New Zealand 3¼% Stock (1963–66)	200 0 0
		£100 East Africa High Commission 3½% Stock (1966–68)	97 10 0
		£400 British Electricity 3½% Stock (1976–79)	396 0 0
		£250 Birmingham Corporation 2½% Stock (1966–71)	250 0 0
		Cash	12 0 0
	£2,808 12 6		£2,808 12 6

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholars	240 0 0	By Balance (as per last Account)	147 7 11
		„ Interest received	91 14 0
		„ Balance carried to Balance Sheet	18 1
	£240 0 0		£240 0 0

WILLIAM GEIPEL SCHOLARSHIP TRUST FUND

	£ s. d.		£ s. d.
Capital Account	£1,292 18 1	Investment (at cost): £1,583 11s. 10d. 3½% War Stock	1,292 18 1
	£1,292 18 1		£1,292 18 1

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Balance carried to Balance Sheet	27 14 3	By Interest received	27 14 3
	£27 14 3		£27 14 3

DAVID HUGHES SCHOLARSHIP TRUST FUND

	£ s. d.		£ s. d.
Capital Account	2,000 0 0	Investment (at cost): £2,045 Metropolitan Water Board (Staines Reservoirs) 3% Guaranteed Debenture Stock (1922 or after)	1,998 15 0
		Cash	1 5 0
	£2,000 0 0		£2,000 0 0

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Balance carried to Balance Sheet	83 2 0	By Balance (as per last Account)	21 15 0
		„ Interest received	61 7 0
	£83 2 0		£83 2 0

I.M.E.A. SCHOLARSHIP FUND

	£ s. d.		£ s. d.
Capital Account	15,202 0 11	Investments (at cost):	
		£5,965 5s. 10d. 3½% War Stock	5,965 5 10
		£4,500 3% Savings Bonds (1960–70)	4,500 0 0
		£1,867 0s. 9d. British Electricity 3% Stock (1974–77)	1,736 15 1
		£1,000 Bristol Corporation 3½% Stock (1961–66)	1,000 0 0
		£1,000 Coventry Corporation 3½% Stock (1960–64)	1,000 0 0
		£1,000 Paisley Corporation 3½% Stock (1958–60)	1,000 0 0
	£15,202 0 11		£15,202 0 11

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholars	735 0 0	By Balance (as per last Account)	507 14 10
„ Balance carried to Balance Sheet	277 10 8	„ Interest received	504 15 10
	£1,012 10 8		£1,012 10 8

JOHN DOUGLAS KNIGHT AND ELIZABETH DUNCAN KNIGHT FUND

	£ s. d.		£ s. d.
Capital Account	980 2 9	Investments (transferred):	
		£333 6s. 8d. 3% Savings Bonds (1960–70)	333 6 8
		£624 9s. 6d. 3½% Conversion Stock	624 9 6
		Cash	22 6 7
	£980 2 9		£980 2 9

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholars	40 0 0	By Balance (as per last Account)	25 11 0
„ Balance carried to Balance Sheet	17 8 0	„ Interest received	31 17 0
	£57 8 0		£57 8 0

SIR EDWARD MANVILLE SCHOLARSHIP FUND

	£ s. d.		£ s. d.
Capital Account	5,000 0 0	Investment (at cost):	
		£5,000 3% Savings Bonds (1955–65)	5,000 0 0
	£5,000 0 0		£5,000 0 0

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholars	262 10 0	By Balance (as per last Account)	92 5 8
		„ Interest received	150 0 0
		„ Balance carried to Balance Sheet	20 4 4
	£262 10 0		£262 10 0

HENRY NIMMO PREMIUM FUND

	£ s. d.		£ s. d.
Capital Account	150 0 0	Investment (at cost):	
		£253 8s. 11d. 2½% Treasury Stock (1975 or after)	150 0 0
	£150 0 0		£150 0 0

PAGE PRIZE FUND

	£ s. d.		£ s. d.
Capital Account	100 19 5	Investments (at cost):	
		£50 3½% War Stock	50 19 5
		£56 4s. 5d. British Electricity 3% Guaranteed Stock (1968–73)	50 0 0
	£100 19 5		£100 19 5

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Award of Prize	4 11 7	By Balance (as per last Account)	6 5 7
„ Balance carried to Balance Sheet	5 2 8	„ Interest received	3 8 8
	£9 14 3		£9 14 3

SIR CHARLES A. PARSONS MEMORIAL SCHOLARSHIP

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Balance as per Bank Account	98 9 6	By Balance brought forward	47 2 0
		„ Interest received	51 7 6
	£98 9 6		£98 9 6

NOTE.—The Capital of this Fund is invested by the Charity Commission.

PAUL SCHOLARSHIP FUND

	£ s. d.		£ s. d.
Capital Account	4,000 0 0	Investments (at cost):	
		£3,019 3s. 7d. 3½% Funding Stock (1999–2004)	3,000 0 0
		£625 4% Funding Stock (1960–90)	500 0 0
		£562 4s. 7d. British Electricity 3% Guaranteed Stock (1968–73)	500 0 0
	£4,000 0 0		£4,000 0 0

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholar	18 10 0	By Balance (as per last Account)	48 14 9
„ Balance carried to Balance Sheet	177 15 5	„ Interest received	147 10 8
	£196 5 5		£196 5 5

SALOMONS SCHOLARSHIP TRUST FUND

	£ s. d.		£ s. d.
Capital Account	2,044 15 4	Investment (at cost):	
		£2,485 10s. 7d. Commonwealth of Australia 3% Stock (1972–74)	2,044 15 4
	£2,044 15 4		£2,044 15 4

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Balance carried to Balance Sheet	135 5 0	By Balance (as per last Account)	60 13 8
		„ Interest received	74 11 4
	£135 5 0		£135 5 0

SWAN MEMORIAL SCHOLARSHIP FUND

	£ s. d.		£ s. d.
Capital Account	3,312 15 10	Investments (at cost):	
		£905 10s. 4d. 3% Savings Bonds (1960–70)	995 0 6
		£1,200 British Electricity 3½% Stock (1976–79)	1,194 4 0
		£1,135 17s. 9d. 3½% Conversion Stock (1961 or after)	1,123 11 4
	£3,312 15 10		£3,312 15 10

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholar	30 0 0	By Balance (as per last Account	260 1 7
„ Balance carried to Balance Sheet	339 0 1	„ Interest received	108 18 6
	£369 0 1		£369 0 1

THORROWGOOD SCHOLARSHIP TRUST FUND

	£ s. d.		£ s. d.
Capital Account	1,000 0 0	Investment (at cost):	
		£1,005 Agricultural Mortgage Corporation 5% Debenture Stock (1959–89)	1,000 0 0
	£1,000 0 0		£1,000 0 0

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholars	43 15 0	By Balance (as per last Account)	91 4 11
„ Balance carried to Balance Sheet	97 14 11	„ Interest received	50 5 0
	£141 9 11		£141 9 11

WAR THANKSGIVING EDUCATION AND RESEARCH FUND (No. 1)

	£ s. d.		£ s. d.
Capital Account	1,700 0 0	Investment (at cost):	
		£2,000 3½% War Stock	1,700 0 0
	£1,700 0 0		£1,700 0 0

INCOME ACCOUNT

	£ s. d.		£ s. d.
To Amount paid to Scholar	75 0 0	By Balance (as per last Account)	136 5 0
„ Balance carried to Balance Sheet	131 5 0	„ Interest received	70 0 0
	£206 5 0		£206 5 0

WILDE BENEVOLENT TRUST FUND

	£ s. d.		£ s. d.
Capital Account	3,048 10 2	Investments (at cost):	
		£1,397 18s. 6d. British Transport 3% Guaranteed Stock (1978–88)	1,744 3 11
		£100 London County 2¾% Consolidated Stock (1960–70)	101 8 6
		£250 Commonwealth of Australia 3% Stock (1972–74)	250 0 0
		£500 3½% War Stock	501 9 3
		£381 15s. 1d. 4% Funding Stock (1960–90)	300 0 0
		£200 3½% Conversion Stock (1961 or after)	151 8 6
	£3,048 10 2		£3,048 10 2

INCOME ACCOUNT

	£ s. d.	£ s. d.		£ s. d.
To Grant authorized		104 0 0	By Balance (as per last Account)	51 17 4
„ Balance—Deposit Account	37 15 3		„ Interest received	93 3 6
Tax Recoverable	3 5 7			
		41 0 10		
		£145 0 10		£145 0 10

'The Impact of Engineering on Society'

The Second Graham Clark Lecture

The Lecture was delivered by Sir Maurice Bowra, F.B.A., M.A., D.Litt., in the House of The Institution of Mechanical Engineers on the 27th April, 1956

THOUGH I am much honoured and flattered by your invitation to speak to you this evening, I cannot conceal that I have no qualifications to do so. I am, I fear, a living fossil, a specimen of unmechanized and even of pre-mechanized man, in my own way as outdated as the coelacanth or the metasequoia. I cannot drive a car. I typewrite with two fingers. I am singularly maladroit when it comes to mending the most humble things. But perhaps it may be instructive for you to know that such people exist, for whom your own resplendent universe of intellectual endeavour is a closed mystery, an enchanted domain which they indeed admire from outside but whose secrets they can never hope to share. I hope you will not think me impertinent if I claim that even so ignorant a view as mine may perhaps serve some purpose. It is often profitable to see ourselves as others see us, especially if we practise some highly skilled and specialized pursuit. However ill-informed the views of an ignorant stranger may be, there is always a hope that they may give us a new angle or turn our minds to something which we have neglected. I have often wished that we possessed, for instance, the record of what the first American Indians thought who were brought to the court of Queen Elizabeth I. It would indeed be strange. Much of it would be quite wrong and even absurd, but somewhere in it there might be a new ray of light of which no Englishman would have thought and which would yet illuminate that remarkable world. I would ask you to look upon me as just such an aboriginal, snatched from his own world and fascinated by the mysteries of yours. My own studies are concerned with the study of man, even if they approach him from a rather special and specialized angle, and no student of man can afford to be unaware of what engineering means in history. I will therefore do my best to speak from my own standpoint and hope that it will not seem to you to be too misinformed, too reckless, or too infantile.

Man, says Beaumarchais, differs from the beasts only in drinking without being thirsty and in making love all the year round. However important these differences may be, and please do not think that I underestimate them, I would claim that man differs from the beasts mainly in being able to turn nature to his own use. Of course some animals can do this, but only on a very small scale. The pride of man is that he has already done so on a large scale, and seems likely to do so on a still larger one. By the construction of inanimate objects, which we call machines, we have extended on an incalculable scale what we are able to do. The process began a very long time ago, but it has on the whole been slow until quite recently, and it has by no means been regular. At the very start are the unknown inventors, who made discoveries which indeed showed what the control of natural forces may mean. If, as is possible, Pekin man, *Pithecanthropus Pekinensis*, really knew how to make fire, it is possible that he should be regarded as our forerunner, since without his discovery nothing would have happened. If he was closer in his structure to the apes than to *homo sapiens*, our debt to the beasts is greater than we usually admit and there is much to be said after all for having our ancestors not in Paradise but in the Zoological Gardens. If Pekin man does not quite qualify to be the patron saint of engineers, he should perhaps be remembered on their Founder's Day and have a place in their Golden Book of Benefactors.

Now almost every society of which we know anything practises engineering to some degree. Even the Australian aborigines invented the boomerang, which was an ingenious and amusing means of hitting your enemies. But it is only in the last hundred or so years that society has really become mechanized on a large scale. The difference between ourselves and the ancient Egyptians is not that we admit the existence of engineering and they did not, for after all the construction of the Pyramids was an extraordinary achievement, but that they did not see the range of its possibilities. A considerable degree of civilization can be secured with a minimum of engineering and, though we must certainly admit that without engineering civilization is impossible, it is not always of first importance. In the eighteenth century China under the great Manchu Emperors not only appealed to the philosophers of the west as a model of good government and social graces, but can be seen to-day to have shown a remarkable capacity for organizing an enormous area into law and order and for producing, at least in a limited class, a high degree of intelligence, sensibility and creative endeavour. The Chinese, who led the world in the invention of printing, the mariner's compass, and gunpowder, did not advance from these auspicious beginnings but evolved a civilization in which engineering had almost no place. Even their buildings, graceful and charming though they are, were modelled on tents and called for no great skill in their erection. It is true that the Emperors used Jesuit missionaries to make fountains and clocks, but there they stopped. So far as the external equipment of life went, China in the eighteenth century differed in no essential respect from China in the first. The Chinese, for all their intellectual gifts, failed to see how important even

clocks and fountains might be to those who understood the principles on which they worked, and in due course they paid heavily for this when a mechanized Europe attacked them and imposed its will on them.

An even more notable example of this neglect can be seen in the Greco-Roman world. The Greeks were in some respects pioneers of engineering, and the many buildings which still bear witness to Roman competence belong to the same tradition. There were indeed times when it looked as if the Greeks were on the verge of great mechanical discoveries. Archimedes not only was a mathematician of incomparable genius but at times turned it to practical uses, as when he invented hydrostatics or devised engines of war to confound the Roman besiegers of Syracuse. Yet, despite these promising beginnings, the Greeks stopped and did no more for engineering. Nor did the Romans after them. And for this, like the Chinese, they paid a heavy price. If the Romans of the later empire had only had another Archimedes to invent new engines of war, they would have had no more difficulty in disposing of Attila and Alaric than Kitchener had in disposing of the Khalifa. The trouble with a society which does not believe in engineering or see its possibilities is not that it cannot be civilized, but that it is not likely to survive. Civilization is a sensitive plant, and its first duty is to look after itself.

This failure of two great systems deserves a moment's notice. We cannot but ask why neither China nor the classical world exploited the possibilities of engineering. Whatever the cause was, it cannot be ascribed to religion. Neither the system of Confucius nor the Olympian Pantheon was opposed to the mechanical sciences. Indeed in their early days the Greek gods were regarded as patrons at least of building and handicrafts, and Hephaestus was without doubt an engineer in the modern sense when he made mechanical beings to work for him in his arms factory. The explanation must lie elsewhere, and perhaps we may find an illuminating hint in what Plutarch says of Archimedes and his more practical inventions:

> 'Though these inventions had obtained for him the renown of more than human sagacity, he yet would not deign to leave behind him any written work on such subjects but, regarding as ignoble and sordid the business of mechanics, and every sort of art which is directed to use and profit, he placed his whole ambition in those speculations the beauty and subtlety of which is untainted by any admixture of the common needs of life.'

Now we might think this no more than the personal whim of a pure mathematician who preferred his own chosen field of geometry to any impure application of it. But the important fact is that this was the normal attitude both in the Greco-Roman world and in China. The engineer was somehow thought to be sordid and engaged in tasks below the dignity of a civilized man. We might, of course, say that you must expect this to happen when education is almost entirely based on the study of literature and words have such a priority of prestige that anything else fades before them. Now this may well be true of China or imperial Rome, and I must admit with regret and shame that too exclusive a study of words may well breed illusions of grandeur about their preeminence and blind their devotees to other matters of first importance. But this is hardly true of Archimedes. He was certainly not a pure product of a literary education. He had behind him some three hundred years of mathematical and even of scientific thinking, which did not shrink from experiment and liked to confirm its theories by precise observation. It seems as if we must look deeper for an explanation.

The contempt for applied mechanics displayed by Archimedes was a product of a society in which there was no shortage of cheap human labour. The trouble with the ancient world was that it never had any difficulty in finding men to do tasks which we assume should be done by machines. Some of these tasks must have involved a hideous expense of effort, and whether we think of the Pyramids or Stonehenge or the Great Wall of China or the roads of the Roman Empire, in each case we must remember that, though some mechanical appliances were used, most of the work was done by human hands. The existence of an inexhaustible labour-pool, of men who for the barest and meanest subsistence were able and ready to carry out tasks of great physical difficulty, meant that the educated and governing classes never turned their minds to other, and better, ways of getting such work done. Their minds, so brilliant and active in other ways, were on this point closed. Because human labour was so abundant, it never occurred to them that this was not the best way of doing what they wanted to do, still less that it could not do everything possible for men. They assumed that this was the unchanging pattern of human life and never looked beyond it. If inventions were to come, they would not be from those who alone had the power to see that they were used, and if some more far-sighted man saw their possibilities, the chances were that he would find nobody to listen to him. By a happy accident we have a treatise written by such a man at the end of the fourth century A.D. We do not know his name, but his tract *On Things of War*, which recommends some ingenious new military engines, shows the position, when he says:

> 'It is universally agreed that in the technical arts (among which we include the invention of weapons) progress is due not to those of highest birth or immense wealth or public office or eloquence derived from literary studies but solely to men of intellectual power (which is the mother of every excellence), depending as it does on a happy accident of nature.'

The Romans, like the Chinese, rejected machines in the last resort because their ruling classes were snobs.

This is a social fact of first importance, and it is not irrelevant to modern times. The prodigious growth of engineering since the end of the eighteenth century has

indeed been rendered possible by the epoch-making inventions like the internal-combustion engine, but this itself would never have happened, or at least never have been turned to general use, if there had not been a complete change towards the part played by engineers in society. The old snobbish position had been so complacent that it was not so much hostile to engineering as completely oblivious of it. What was needed was something to break this complacency and suggest that after all engineering might do good even to those who thought they needed it least. This change was mainly due to the vast revolution worked by the dramatic appearance and rapid growth of natural philosophy. Just as the first Greek scientists moved without difficulty from inquiring about the nature of Being into inquiring about the nature of Becoming, and thereby opened the door to all kinds of physical speculation, so the natural philosophers of the seventeenth century saw that it was impossible to separate the nature of things from their appearances, and conducted experiments to see how things work as they do. The revival of observation and experiment, which had been almost dead since Aristotle conducted his great researches into biology, meant that nature began to become intelligible, and when this happened, men saw that they could make use of it.

This momentous change was not made without obstacles. Even after the foundation of the Royal Society and the first brilliant outburst of scientific speculation which came with it, it looked at one time as if it would again fade away as it had centuries before. It was saved by the recognition that machines could do much that men cannot do by themselves, and though such an idea might still seem absurd or repugnant to the select and privileged few, it was welcomed by others who saw in it a hope for improving their own lives and conditions. Economic forces undoubtedly played an important part. Once they began to undermine the old social order and to create opportunities for many who had hitherto been forced to be content with a humble station, they set new challenges which soon found responses. Once it was clear that it was both profitable and honourable to know about mechanics, mechanics began again to produce its own men of genius, and from the time of Newton onwards the process has continued not merely without interruption but with ever-increasing force and popularity and respect.

It is important to note that this vast change has not been revolutionary in the political sense. It has indeed changed the whole appearance of society and done much to change its structure, but it has not been aided by political revolution or had very much to do with it. The leaders of the French Revolution were not the new and small class of engineers but lawyers, doctors, lapsed priests and impoverished journalists. The Russian Revolution made its first and by far its strongest appeal to a peasantry appalled by the destruction of war and hungry for land. The Chinese Revolution was the final stage of a long struggle against officials, landowners and moneylenders. In none of these did applied science play any leading part or supply anything like a revolutionary ideology. Indeed we may suspect that if these three countries had been more mechanized than they were, revolution might not have come at all or have come in a different, less virulent, form. It was because these people felt that violence was the only solution for their troubles that they took to it. Now engineering tends to suggest always that there is a cure for most evils, and that the age-old troubles of man such as starvation, disease, floods, and the like can be surmounted by a proper use of machines. It is indeed significant that the classic case of growth without revolution should be in a country which has used engineering on the greatest possible scale. The United States, which was brought to birth by revolt, has, despite the inevitable disorders of its first expansion and the catastrophe of the Civil War, never come near to social revolution and seems determined at all costs to avoid it. This is all the more remarkable when we consider how many immigrants in the nineteenth century arrived with advanced radical opinions and how sharp the social conflict was in the period of the great millionaires after the Civil War. Here, we might think, was an ideal powder-barrel, ready to blow up at the first application of a match. But it has not. Though the United States owes more than any other country to the practical application of mechanics, and has won its successes with a good deal of strain and trouble, it has remained remarkably faithful to its fundamental assumptions of what American life ought to be.

If, as we well may, we regard politics as the struggle for power, engineering is not a political activity. It aims at something quite different—the control and exploitation of natural resources to give a greater degree of human welfare. It becomes political only when its very existence is threatened by authority—and that may have been common enough in the past but seems less and less likely to be common now—or when it is taken up by authority for its own ends. In itself it stands outside and beyond politics, and the outlook which it represents is essentially non-political; if we wish to know what it means for society, we must not look at it entirely or even mainly from a political angle. It embodies in the first place a special outlook, which is that man's struggle for existence cannot merely be maintained by exploiting natural resources but can even be made progressively less laborious as knowledge of their control increases. This is not a Utopian dream, not another form of the old wish to regain a lost Paradise or to return to a Golden Age. It can call as witnesses to its realistic good sense its own achievements and show that these have indeed done something beyond reckoning to ameliorate the human lot and positively to improve it. It is all very well to look back with regret to the age of the Antonines or of Louis XIV or even of George III, but I am very suspicious of this particular brand of intellectual opium. I would not deny that our own century has had its appalling catastrophes, but I would confidently assert that life is more agreeable now for the mass of mankind than it has ever been, and that this is almost entirely due to man's increasing conquest of nature through machines.

Agreeableness may not be everything, and not even a final test, but it is after all something, and this at least we owe to the engineers.

The engineer works within his own social frame, and as the modern world is organized into national states, his work has to be shaped to suit them and their demands. Within these limits his work is a strong stabilizing influence. On the one hand it avoids the angry discontent which is inevitable when no change seems possible, and on the other the complacency which assumes that everything is after all as good as it can be and that nothing need be done about it. Unlike the fine arts, which are always having to make a fresh start because something has been done so well that it cannot be done again, it moves in an ordered progress in which every new step is a real advance and leads to others beyond it. Such a process satisfies both man's desire for order and stability and his love of novelty. He likes to think—and who shall blame him?—that many new delights lie round the corner, but he shrinks from paying too heavy a price for them. Each new discovery has to be turned to practical use, brought into general circulation, and consolidated inside the social frame. This takes time and patience, but nobody denies that it is worth it. A society which has become accustomed to seeing its own life improved by many inventions will develop a rational approach to its problems, realize that stability is something almost beyond price and be very cautious of losing it.

This aspect of engineering is extremely relevant to the modern world. In the last forty years some eight hundred million people have passed through violent revolutions which have destroyed the fabric of society in which their fathers lived. These revolutions have indeed been political in that they have transferred power from one class of people to another and have held out enormous promises of improved ways of living. Both in Russia and in China revolution has been followed by prodigious efforts to apply science to all kinds of life. Now in this there is undoubtedly an element of propaganda. When promises have been made, men will ask that they are kept, and the most sensible way of keeping revolutionary promises is to increase prosperity by engineering. Nobody will dispute the practical wisdom of Stalin or of Mao-tse-tung in telling their peoples that, if they will only study the right technology, all will in the end be well and the rapturous hopes of their youth fulfilled. But this element of worldly wisdom is matched by another. The governing classes of revolutionary states may have come to power by violence, but the last thing they want is that this violence should continue and be turned against them. They see that if they can only induce a proper respect for engineering, their subjects will realize that conditions can indeed be improved and will put up with a good deal of discipline and regimentation in the hope that in the end they will be better off. They are wiser in their generation than the later Emperors of Rome or the Manchu Emperors of China, since they see that, though men can feed on hopes for a long period, sooner or later these hopes must be turned into something more substantial.

If we could believe in progress with the happy optimism of the nineteenth century, we might well think that the increasing command of mechanics would inevitably lead to the greater happiness of mankind. In principle there is no reason why it should not, but our own age has issued too many warnings against vaulting hopes for us to be able to believe it. It has learnt to its cost that mechanical progress can too easily be defeated by political insanity, and that just because engineers are confined to their own social and national systems, they can do little or nothing to prevent it. Though our own century has made technical advances quite as great as those of the nineteenth, it has not enjoyed that prolonged peace which Great Britain enjoyed from 1815 to 1900 or that sense of security which is based on the belief that most social problems can in the end be solved by a more generous distribution of material goods. Both international war and class war have dominated and damaged our lives despite the obvious increase in most countries of prosperity and ease. For this we must blame man in his capacity of a political animal. He has failed to evolve means by which his desire for security and prosperity can be combined with other darker and less rational forces in his nature. We cannot but ask whether engineers must not to some degree bear the blame for this, whether they have not, albeit unwittingly or unwillingly, sharpened these conflicts and made them more deadly.

In a fair judgment, if the engineers are to blame at all, it is for sins of omission rather than of commission. I would not deny that they have created weapons of destruction such as our ancestors never dreamed of, but at least it can be said on their behalf that in this they were the agents and the servants of political power, that it was not after all their own ambition to fashion instruments which may blow up the world. The blame for this lies with the mass of men who insist upon destroying each other. Where the engineers have gone wrong is perhaps in taking too modest a view of their own task and their own duties. They have set out, in all sincerity and decency, to improve the human lot, and they have assumed, reasonably enough if the world were reasonable, that this means a greater exploitation of natural resources for the general benefit of humanity. But this, unfortunately, is not always what humanity asks for. When, for instance, we look back to 1914 and see how prosperous Germany was, how rapid were her advances in all branches of applied science, how doctors of engineering from the *Technische Hochschule* at Charlottenberg seemed to have before them the whole wide world from the Rhine to the Yangtse, we must surely be amazed not only that the Germans insisted upon going to war but that they acted in a spirit which denied and rejected the good things which were already theirs so abundantly. It is impossible to read the German literature of the age of William II without seeing how many serious and high-minded Germans desired war as a protest against what they thought to be the enfeebling, unmanly influence of peace. Nor was this spirit confined to Germany. It was hardly less obvious in England where

young men like Rupert Brooke went gaily to their dooms in the conviction that they were getting away from a scheme of life which stifled their best impulses and placed far too much emphasis on comfort and security. This spirit was indeed to perish in the blood baths of the Somme and Paschendaele, and an angry reaction set in against it. But it is never very far from the surface and has asserted itself again more than once in more brutal and less romantic forms. While the engineers labour to make life easier and more agreeable, the mass of men accepts their contribution for a time and then, in wild frenzies of unreason, rejects it and destroys it.

For this I can see no cure. It is not easy to find an emotional equivalent to war for those who like war, or at least like to send others to it. But if what is wanted is excitement, if what some men resent in ordered society is that it is too dull, there can be no doubt that engineering can offer them thrills in plenty. The conquest of the air, which we now take almost for granted, has provided not only problems to be solved at the highest intellectual level but the practical application of their solutions with a confidence which is the modern equivalent of heroic courage. The conquest of famine and drought by the proper control of water supplies calls for generalship at the top and consummate discipline and skill among the other ranks. The exploitation of new sources of power calls both for strategy and for tactics in many unfamiliar corners of the globe and evokes visions of advances over enormous fronts. Engineering, more perhaps than any other branch of human activity, provides an imaginative equivalent to war, and has the advantage that it creates instead of destroying. Whether mankind will learn this in time is perhaps too much to ask. But let us at least indulge in a faint and pious hope that it will.

If it is true that some men find a well organized and well mechanized life so dull that their only release is violence, we can at least say that it is their own fault and that they have only themselves to blame. For to be bored to this degree is surely a terrible failure in oneself. But there are more subtle and more specious criticisms than this against the growing part which engineering plays in the world, and especially against the almost incredible increase of speed in communications which we have seen in our own lifetime. When I was a boy I rightly thought it wonderfully exciting to travel from London to Peking by Siberia in a fortnight; how different from the six or more weeks by sea. But now a fortnight seems far too long for a journey to anywhere except to the moon. To the man for whom travel is a means to something else this increase of speed is of course a blessing. He wastes far less of his time than before in getting from one place to another. Air travel may be dull, but it is not so dull as a long journey by sea or so dirty as a long journey by train. In the short time at our disposal in this life it may be comforting to know that we waste less of it than we used to on the mere means of our professions and have more time to devote to their ends. Yet we may perhaps wonder whether this change in the whole character of communications has not been bought at rather too heavy a price.

Nobody who is interested in human beings can fail to take pleasure in their enchanting variety, not merely in their individual differences but in their differences of customs and thought and circumstances. The great humanistic tradition which has dominated our thought for some four hundred years accepts the variety of men as something delightful and desirable in itself and judges the worth of a civilization by its ability to sustain the widest variety possible. When we think of the rich range of existence which was taken for granted in Italy in the fifteenth century, or in France in the nineteenth, we cannot but feel respect for the ideal which holds that freedom expresses itself in variety, and that variety is a test of the richness of life. Conversely, to conform to a standard pattern seems to be an admission of defeat, of an inability to get beyond mere existence to a good existence, of a lack of enterprise and ultimately of a real self. Anyone who likes the human species and enjoys its capacity to express itself in different ways must surely be a little alarmed by the formidable drive towards conformity in our time. It is, of course, partly a political matter. The governing class of Russia spares no pains to turn its curiously assorted victims into a respectable imitation of the old bourgeoisie, and its motives are clear enough. It feels that once such respectability is established and becomes common form, the whole business of government will be easier and safer. In the United States the desire for conformity is no less powerful but comes not from above but from below, from a real desire to have a common, American way of life, in which everyone feels at home and knows that he will not be troubled by anomalies and eccentricities. But though the drive towards uniformity is undeniably political in its origins, it has no less undeniably found a powerful ally in engineering.

The revolution of communications has meant a vast change in traditional ways of life by the introduction of standard, international objects of every kind. The process which began with the bicycle and the sewing-machine has extended to most mechanical devices and no doubt Bokhara is as proud of its up-to-date materials as Peking. Yet on the whole this air of 'Westernization' is probably more superficial than we think. Of course there is an international level of comfort which spreads along the main lines of communications and supplies the same meals, the same drinks and the same opportunities for hygiene wherever it occurs, but this after all is meant for foreigners and does not touch the local inhabitants. They will maintain their own *cuisine bourgeoise* and reject all temptations to be 'Ritzy' in their *confort moderne*. Indeed the spread of Western gadgets to Asia may even have its own charm. It is the modern equivalent of the Baroque Churches which the Portuguese built at Goa and Macao, or those resplendent palaces which the English built in the best Regency style at Hyderabad or Corfu. We cannot expect any material civilization to remain static, and the archaeologists of the future will probably be as delighted to find remains of gramophones and wireless sets in Ulan Bator as their present

counterparts are to find Roman coins and pottery in Travancore.

Nor need we deplore the way in which most languages now absorb with consummate ease words from other countries. The French have long set a mysterious example with their use of 'un footing' or 'un dancing,' but there are few languages which do not yield to the same temptation. For a time the Chinese resisted the adoption of foreign words and preferred to call whisky 'fire-water', but I am told that this is now out of fashion and whisky is simply whisky, just as the Bulgarian for 'mackintosh' is 'mackintosh'. The Russians, who began by calling a railway terminus 'voksal', which comes from Vauxhall, have from time to time resisted foreign words but now, like the Chinese, have given up the struggle. Even modern Greek, torn as it is by dissension between using a stiff, Byzantine, 'pure' language and the lively varied speech of the common people, cannot resist such modernities as ἀμένεξ and αἴλαυφ. Most languages have a remarkable gift for absorbing words from abroad. The process is probably as ancient as civilization, and the first Greeks were delighted to take over such pre-Greek words as those for such non-Greek things as bath-tubs, beans, hyacinths, and wicker-baskets. When the Germans insist on calling the telephone 'Fernsprecher', they show an unbecoming nationalism, and an ignorance of the laws of that philology to which they have given such patient and untiring toil. These linguistic oddities have of course increased with the increase of communications, but they do not in fact detract from the charm of the languages which assimilate them.

A more serious charge against the influence of engineering is that it interferes with the variety of the individual self and shapes it to a uniform mould by imposing certain patterns on it through modern organs of indoctrination such as the Press, cinema, wireless and television. It is claimed that these means of instruction and propaganda are far more tyrannical than the old-fashioned means of books because they are cut to a close pattern and allow very little choice. It is perhaps not enough to say that we need not listen to them unless we wish; for sometimes we may be in a mood to listen to anything, and then, it seems, the deadly work begins. Now of course if we compare the means of information which the ordinary man of to-day has in comparison with the privileged man of a hundred years ago, there is no doubt that it is more stereotyped and far more likely to create what is disagreeably called a mass mind. The danger is indeed great when these means of information are controlled by a single authority which wishes only certain things to be known, and those not necessarily true. We have seen this happen in Germany and Russia, and we know how dangerous it can be when even the most honest and independent people are so circumscribed in their sources of information, and so cut off from any other sources, that they are almost forced into certain opinions. Hardly less dangerous is the situation in relatively free countries when an exaggerated respect for the views of misguided but touchy minorities forbids the public expression of anything which might cause them pain. Truth flourishes on controversy, and when the B.B.C. seeks to avoid it or to reduce opposite points of view to a woolly muddle, it betrays its heritage and shirks its chief duty.

Against this somewhat depressing prospect we may set certain considerations which carry some weight. The whole of this new system of imparting information, to call it by no ruder name, is still in its infancy. It is quite possible of course that it may grow much more powerful and exert a more stifling influence than at present. We must at least be awake to this possibility and beware of it. On the other hand we may safely assume that the whole machinery of broadcasting and television will grow to such an extent that before very long anyone in one part of the world will be able to see or hear a programme from any other part. No doubt powerful efforts will be made to stop this, but it is unlikely that they will be any more successful than efforts have been in our own time to stop listening to forbidden programmes from London or Berlin or Athens. As the programmes multiply, the innate curiosity or perversity of men will lead them to pay attention to much which is not supposed to concern them. In their early days these vast new means of propaganda have indeed been formidable instruments for imposing at least a superficial uniformity, but we may well doubt whether they will keep their supremacy in this direction.

Another source of hope, if not quite of confidence, may be found in the undeniable tendency of men who have a special, difficult job to think for themselves. However bad their original education may have been, once they master a technique or a technology, they are almost forced to shape their own philosophy on it. They know it so well that they cannot help noticing at times that facts are not what they are commonly said to be, that there is more than one way of looking at a problem, that what may work as a passable truth in other professions does not work in theirs. This consideration is of first importance in a world where technology of every kind is becoming more complex and more difficult every day. Just because many tasks are more specialized, they demand a higher degree of trained intelligence, and do much of their own training for it. The job makes the man and shapes his critical sense of reality. It is a false criticism to say that specialization narrows the intelligence. On the contrary it is usually when we are specialists in one thing, that we are able to look at other things outside our own sphere with a new detachment and insight. Of course this implies a reputable degree of education, but that too is indispensable if we are to have the specialized technologists whom we need. You cannot set a man to work a difficult machine if he is unable to think within reasonable limits. So in the end it looks as if engineering, which has undoubtedly played into the hands of some of our new bosses by its skill in shaping thoughts, will change its direction and make it easier for those thoughts to be free.

A final objection raised to engineering in social life is that it imposes a standard of culture which lacks the

variety and the beauty of old craftsmanship, that it substitutes the dead products of machines for the fine work of men's hands, that it destroys the grace of life even in the small, select circles where it is still cultivated. Now it is perfectly true that most machine-made articles have not the charm and the distinction of Chippendale or Wedgwood, that concrete lacks the variety of texture and colour to be found in stone, that mass-production must inevitably destroy the old delight of the eyes in things made by hands. It may well be the case that increased production will spoil some of the old fine art of workmanship. But we should not allow this to get out of proportion nor should we allow wrong conclusions to be drawn from it.

There is indeed something to be put on the other side. The more remarkable developments in architecture in our time are triumphant feats of engineering, and it would not be wrong to say that the no less remarkable failures, which we can see abundantly around us, are due to a refusal to think logically about what engineering can do for building. The enormous development of scale which it makes possible calls for a new style of architecture, and it is useless to disguise this under old clothing, whether Gothic or Banker's Georgian, or Rothschild Second Empire. The whole strength of a good modern building is that it can, because of its materials, rely on purity of line and simplicity of design. It can really give an effect of height without such variations as older builders needed to keep it erect. How important this is can be seen from the development of American skyscrapers. The first of them, like the famous 'flat-iron building', still kept some traces of Victorian decoration, but they did not need it, and it did nothing for them. Rather it detracted from their essential simplicity of line and balance. The latest buildings, like the Rockefeller Center or the United Nations building, have abandoned these and concentrated on the sense of height and strength which modern methods make possible. There is no question that the gain is enormous. Not all kinds of buildings should perhaps be built in this way, but it is a remarkable contribution to the aspect of our cities, and it is a triumph of engineering controlled by a sense of design and harmony.

If such things can be done for architecture, there is no ultimate reason why they should not, as our lives become more mechanized, be done for other things. Steam engines have for nearly a hundred years fascinated the imagination of boyhood, and even now they have not entirely lost their place to aeroplanes. But, whether we travel by train or car or aircraft, there is no reason why the machine should not be a delight to the eye. It needs some adjustment of vision to realize that this is possible, and it is not enough to think that because an engine or a car goes fast it is therefore beautiful. But it is surely a reasonable hope that a new kind of craftsmanship, no less careful, will succeed the old and will provide its own kind of pleasure.

Some historians maintain that civilization becomes degraded as soon as the cultivated tastes of a few are shared by many. It has even been claimed that this was one of the main factors in the decline of the Roman Empire. This certainly is not true. In the Roman Empire one of the chief causes of decline was the ever increasing gap between the rich and poor, and the consequential limitation of arts and sciences to a very small class. Nor is the theory true of modern times. The countries which have shown the greatest intellectual and social advances, France, Great Britain, and the United States, have all managed to extend their refinements to an ever increasing class. Of course such a process will show its growing pains. Of course there will inevitably be failures of taste. Of course there will be maladjustments and mistakes and pretentious impostures. But there is no real reason why a world which relies on machines more than on handicrafts should not in the end produce objects as satisfying as those of the old craftsmen. They will be in more generous supply. They will not be unique treasures. But they will give delight to a far greater number of people than the old system of privileged elegance could ever do, and in the end man's natural desire to do things well will triumph, and a new kind of grace and charm will emerge.

As the Greeks said 'even the gods do not fight against necessity', and for us engineering has become a necessity. It is madness to fight against it, to wish that it had never been. It has brought untold benefits to the world, and if it has often enough been held responsible for our catastrophes, it is we, and not it, who are to blame. I even cherish the hope that it may help to solve some of our political troubles. In so far as it offers by far the surest and safest way to improve the human lot, is it perhaps not too much to hope that in the end the majority of mankind will see that it is far saner to alter social conditions by its controlled and rapid methods than to revert to violence, which always means that an unforeseen situation is created and that too much has to be done all over again? Man's unique position in the scheme of things lies in his ability to turn nature to his own ends, and if he really knows what these ends are, he should be able to do on an ever extended scale what he has already begun to do with such imagination and devotion and skill.

The *POST OFFICE ELECTRICAL ENGINEERS' JOURNAL*

The October, 1956, issue of the *Post Office Electrical Engineers' Journal* will be a special issue celebrating the fiftieth anniversary of the Institution of Post Office Electrical Engineers and will be devoted to articles reviewing the development and growth of the British Post Office telecommunication services and mechanization of postal services. These articles will include the history of development of the main branches of communication engineering. The special issue will be on sale at 2s. 6d. (postage 3d.).

Members who do not subscribe regularly to the *P.O.E.E. Journal* and who require a copy of the special issue are recommended to place an order before the 1st August, 1956. The order should be sent to Messrs. Birch and Whittington, 49 Upper High Street, Epsom, Surrey.

FAMOUS ELECTRICAL PIONEERS ON STAMPS

Notes on philately and electrical engineering by A. E. Shearer, Associate Member, with examples of portrait stamps from his own collection

THE first postage stamp was introduced by an Englishman, Rowland Hill, on the 6th May, 1840—the famous 'Penny Black'. Since that date stamps have been issued by countries all over the world, and it is not surprising, therefore, that a considerable number depict the subject of electrical engineering or portraits of celebrated electrical engineers.

Whilst it would be almost impossible to compile a complete list of such stamps, an extensive—yet not expensive—collection can be made which will cover every branch of the subject. Here we illustrate the human aspect—by reproductions of some stamps bearing the portraits of electrical pioneers and inventors, with a brief note about each stamp. Unfortunately the black-and-white reproductions do not do full justice to the stamps, many of which are more pleasing to the eye in their natural colours.

It is not surprising that the increase in the use of electrical power throughout the world has resulted in the issue of many stamps illustrating power stations. It must be remarked, however, that only very few of these stamps show steam stations, probably because hydro-electric schemes offer a subject more attractive to the stamp designer. The only stamp showing an electrical subject ever issued by the United Kingdom does, surprisingly enough, carry a representation of a steam power station. This is the 2½d. blue issued on the 11th June, 1946, in the Victory Commemoration set.

Many stamps exemplifying telegraphy, radio and even television have been issued by countries as far apart as Argentina, Denmark, Romania and Australia, whilst electric traction has always received good philatelic treatment from those countries whose stamps are not confined to portraiture. Such aspects of the uses of electricity as lighting, welding and electronic equipment have also been included on postage stamps.

For those members of the profession involved in the manufacture of electrical equipment, there is good scope for forming a collection of stamps dealing with their interests; materials such as manganese, hemp, rubber, tin, cotton, steel, etc., are all to be found on what are usually beautiful stamps.

These notes have been based on the author's personal collection of stamps, for which he makes no apology to those readers who are specialists in philately and who are wont to frown upon thematic collectors.

SAMUEL FINLEY BREESE MORSE

This stamp was issued on the 7th October, 1940, in a series depicting famous American inventors. At the bottom of the panel, arranged in the form of a monogram, are reproductions of a cog-wheel, uplifted wings and a lightning flash—symbols of power, flight and electricity.

OTTO VON GUERICKE

This stamp, designed by Richard Klein, was issued in 1936 on the 250th anniversary of von Guericke's death. In addition to his experiments on frictional electricity, von Guericke invented an air pump and was the author of *De Vacuo Spatio*.

THOMAS ALVA EDISON

This U.S. stamp was issued on the 11th February, 1947, on the centenary of Edison's birth. The 50th anniversary of the production of Edison's first electric lamp was celebrated in 1929 by the United States with the issue of a 2c. stamp illustrating his original lamp.

ALESSANDRO VOLTA

A set of four stamps, designed by Professor Giulio Cisari, was issued on the 5th March, 1927, the centenary of Volta's death.

GUGLIELMO MARCONI

The death of Marconi in 1937 was followed by the issue on the 24th January, 1938, of three stamps bearing his portrait. Like the other Italian stamps illustrated, they have a crown watermark. Marconi was elected to Honorary Memebrship of The Institution in 1926.

ZÉNOBIE THÉOPHILE GRAMME

A portrait of Gramme, with a dynamo, appears on this 35c. stamp issued by Belgium in connection with the Liége Exhibition in 1930.

NIKOLA TESLA

Although Tesla became an American citizen, two stamps, bearing his portrait were issued in 1953 on the tenth anniversary of his death, by Yugoslavia, where he was born. He discovered the principle of the rotating magnetic field and adapted it to his induction motor.

OSKAR VON MILLER

The centenary of the birth of one of the founders of the German Edison Company is commemorated on this stamp issued on the 7th May, 1955. Oskar von Miller was president and technical director of the famous International Electrical Engineering Exhibition at Frankfurt in 1891.

HANS CHRISTIAN OERSTED

The centenary of the death of Oersted, the famous Danish physicist and discoverer of the magnetic effect of an electric current, was commemorated on the above stamp, issued on the 9th March, 1951.

ANTONIO PACINOTTI

In 1934 Italy issued two stamps to mark the 75th anniversary of the invention of his dynamo by Antonio Pacinotti, who was an Honorary Member of The Institution.

LUIGI GALVANI

Two stamps bearing the portrait of Galvani, of value 30c. and 75c., were issued by Italy in 1934 in connection with the first International Congress of Electro-Radio-Biology.

ANDRÉ MARIE AMPÈRE

On the 27th February, 1936, the centenary of Ampère's death, France issued this 75c. stamp, which was engraved by A. Delziers.

ERNST WERNER VON SIEMENS

The founder of the renowned Siemens electrical manufacturing concern is portrayed on this stamp, issued on the 12th October, 1952, in the Western Sector of Berlin.

KARL FRIEDRICH GAUSS

This 10-pfennig stamp, designed by H. Eidenbenz and engraved by L. Schnell, was issued by the German Federal Republic in February, 1955, on the centenary of Gauss's death.

JOHANN PHILLIP REIS

The 75th anniversary of the German telephone service was commemorated in 1952 by the issue of this stamp. A contemporary of Bell, Reis was the first to describe publicly an electric telephone, but his attempts at transmitting speech by the make-and-break system of the telegraph were unsuccessful.

ALEXANDER GRAHAM BELL

The centenary of Graham Bell's birth was commemorated on the 3rd March, 1947, with the only stamp so far issued by a member of the British Commonwealth to portray an electrical inventor.

HENRI BECQUEREL

In 1946 France issued this stamp in connection with 'the fight against cancer'. Henri Becquerel, in 1896, was one of the first to discover the radioactive rays given out by uranium salts.

WILHELM KONRAD RÖNTGEN

The discoverer of X-rays, who lived from 1845 to 1923, was honoured by Danzig in a series of stamps, issued on the 29th April, 1939, in connection with an anti-cancer campaign.

CORRESPONDENCE

WHAT IS PERMEABILITY?

From Professor E. G. CULLWICK,

O.B.E., M.A., D.Sc., F.R.S.E., MEMBER

What is permeability? Is it a dimensionless numerical ratio, equal to unity in free space? Or is it equal to B/H, and therefore dependent on the system of units adopted?

These questions are of fundamental importance. The British Standards Institution, supported by The Institution, has pronounced that permeability is equal to B/H and that it should be denoted by μ. Free space, devoid of matter, is therefore alleged to have a permeability, in the rationalized M.K.S. system, equal to $4\pi \times 10^{-7}$. Is it surprising that our friends who teach physics show some reluctance to adopt the M.K.S. system?

The term *permeability* is due to Lord Kelvin,[1] who defined it as

$$\mu = 1 + 4\pi K \quad . \quad . \quad . \quad . \quad . \quad . \quad (1)$$

where K is the magnetic susceptibility or the coefficient of induced magnetization.[2] If M is the intensity of magnetization (magnetic moment per unit volume) and H the magnetic force or intensity, then

$$K = \frac{M}{H} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

and is zero in free space. All this, of course, is in C.G.S. units and μ, in free space, is unity.

So in C.G.S. units $\mu = B/H$. But Kelvin gave precise definitions for B and H in a magnetic medium.[1] Suppose a bar of iron to be uniformly magnetized along its length, and a long and narrow cylindrical cavity to be cut in it, parallel to the magnetic field. Then if the diameter of the cavity is very small compared with its length, the force on a unit magnetic pole situated at the centre of the cavity is equal to H, the magnetic force or intensity. Now suppose another cavity to be introduced, shaped like a very thin flat disc perpendicular to the field: the force on a unit pole at the centre of this cavity is, in C.G.S. units, equal to B, the magnetic induction or flux density.

These are Kelvin's 'cavity definitions' of H and B, and it is evident that, for him, the permeability μ was the numerical ratio of two forces and therefore a dimensionless ratio necessarily equal to unity in the absence of magnetization. In M.K.S. units the respective forces on the unit pole, however, are not H and B but H and B/μ_0, where μ_0 is what the B.S.I. calls the permeability of free space.

This well-known and long-established meaning of permeability is simple and straightforward, with a direct experimental interpretation. If the magnetic flux density inside an 'air cored' toroidal coil is B_0, the introduction of a closed iron core will increase the flux density, the current in the winding being maintained constant, by the factor μ.

Permeability, then, was introduced as an aid in the theory of *ferromagnetism*, before the evolution of our knowledge of the structure of the atom. It is therefore a statistical factor describing the average field in matter in bulk. If there were no ferromagnetic materials, the concept would be unnecessary but the fundamental electromagnetic laws would be unaltered.

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We are now asked, by Authority, to define permeability as B/H in all unit systems. In free space, where there can be no magnetization, we put $B/H = \mu_0$ and are told that this is the *permeability of free space*. The ratio is in fact a fundamental constant which must of necessity be introduced at an early stage in teaching, when a student's ideas are unformed and his mind ready to be led in any direction. He is thus encouraged to adopt the idea, long since obsolete in science, that there is in fact a magnetic *force* H which acts on 'free space' and produces something called *flux*, just as a stress produces a strain in a steel bar. Even if this is held to be the line of least resistance in elementary teaching, it is pedagogically unsound in that it inhibits the later development of a better understanding of a subject which is complex enough without the introduction of unnecessary impediments. It is scientifically unsound because it introduces, into equations describing the behaviour of individual charged particles, a macroscopic concept designed for the theory of the averaged field in matter in bulk.

Moreover, it is often forgotten that the vector measures of the electromagnetic field, E, D, H and B, are *secondary* concepts and purely figments of the human imagination. It is theoretically possible, albeit practically inconvenient, to do without them, as witness the expression for the force experienced by a stationary unit charge in terms of the potentials:

$$F_0 = -\frac{\partial A}{\partial t} - \text{grad}\,\phi \quad . \quad . \quad . \quad . \quad (3)$$

The force F_0 is due solely to charges and currents, and if J and ρ are the current and charge densities in the sources the potentials are given, for ordinary low-frequency circuits where 'retardation' is not necessary, by

$$\phi = \frac{1}{4\pi a}\iiint \frac{\rho}{r} d\tau \quad . \quad . \quad . \quad . \quad . \quad (4)$$

$$A = \frac{b}{4\pi}\iiint \frac{J}{r} d\tau \quad . \quad . \quad . \quad . \quad . \quad (5)$$

The magnetic field measures H and B do not enter these equations at all, but it so happens that the constant b in (5) is equal to B/H in free space so that (5) is written

$$A = \frac{\mu_0}{4\pi}\iiint \frac{J}{r} d\tau \quad . \quad . \quad . \quad . \quad . \quad (6)$$

To persist in calling μ_0, in this relation, the *permeability of free space* is to elevate the concept of the magnetic field to a position of priority, above that of the charges which, stationary and moving, are the primary sources of the actions, and to introduce an entirely unnecessary and irrelevant complication of ideas.

Similarly, the constant a in eqn. (4) happens to be equal to D/E in free space, so it is replaced by ϵ_0, the *permittivity of free space*. Both names are misleading and inappropriate, and are anachronisms which obstruct scientific thought.

I therefore make a strong plea to the British Standards Institution, and to the appropriate committees of The Institution, to adopt the excellent and logical system introduced by Professor Carter.[3] He retains the original meanings, as dimensionless ratios, of permeability and permittivity (dielectric constant), for which he uses the familiar symbols μ and κ, which were orthodox British Standards before the adoption of the M.K.S. system. For the primary constants a and b in eqn. 4 and eqn. 5 he uses, quite rightly, different

symbols ϵ_0 and η_0. We then have, as fundamental relations for a stationary body,

$$\boldsymbol{D} = \kappa\epsilon_0\boldsymbol{E}, \quad \boldsymbol{B} = \mu\eta_0\boldsymbol{H} \quad . \quad . \quad . \quad . \quad (7)$$

or

$$\boldsymbol{D} = \epsilon\boldsymbol{E}, \quad \boldsymbol{B} = \eta\boldsymbol{H} \quad . \quad . \quad . \quad . \quad (8)$$

if it is desired to express the ratios $\boldsymbol{D}/\boldsymbol{E}$ and $\boldsymbol{B}/\boldsymbol{H}$ by single symbols. Eqn. 2, for the magnetic susceptibility, becomes $K = M/\eta_0 H$, while eqn. 1 becomes, in the rationalized system,

$$\mu = 1 + K \quad . \quad . \quad . \quad . \quad . \quad . \quad (9)$$

which leads to, when we multiply by $\eta_0 H$,

$$\boldsymbol{B} = \eta_0\boldsymbol{H} + \boldsymbol{M} \quad . \quad . \quad . \quad . \quad . \quad (10)$$

Summarizing, in rationalized M.K.S. units, we have:

ϵ_0 (the present standard symbol) = primary electric constant = $8{\cdot}854 \times 10^{-12}$ coulomb/volt-metre, or farad/metre.

η_0 (instead of μ_0) = primary magnetic constant, $4\pi \times 10^{-7}$ weber/amp-metre, or henry/metre.

κ = permittivity or dielectric constant (dimensionless ratio, unity in free space).

μ = permeability (dimensionless ratio, unity in free space).

This scheme is completely free from the objectionable implications inherent in the present authoritative system and which comprise a formidable deterrent to the wider adoption, particularly by physicists, of M.K.S. units.

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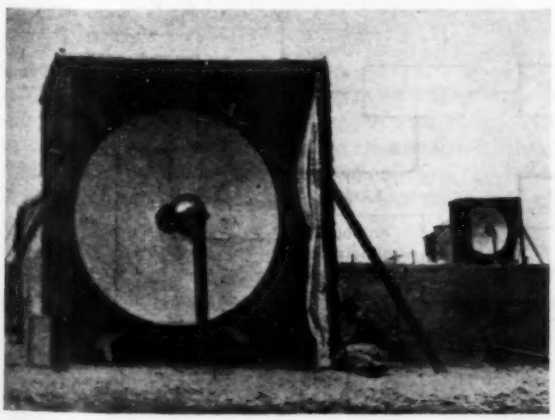
Twenty-five Years of Microwaves

BY E. H. ULLRICH, M.A., MEMBER

ON the 31st March, 1931, a number of British and French personalities held two-way conversations of high quality across the Straits of Dover on a 17 cm-wavelength beam, and this year on the eve of the twenty-fifth anniversary Mr. A. G. Clavier was honoured for his pioneer work in microwave research, which led to this historic demonstration. The ceremony, at which he was given a scale model of the original paraboloidal reflector, took place quietly in the club-house of Federal Telecommunication Laboratories at Nutley in New Jersey. Mr. Clavier is now Vice-President and Technical Director of this company.

I well remember chatting from the French side on that fine March morning in 1931 with Colonel Sir Thomas Purves, the Chief Engineer of the British Post Office and Past-President of The Institution, who was on the English side of the Channel, and I particularly enjoyed reminiscences that I exchanged in a similar manner with Colonel (now Sir George) Lee and Mr. (now Sir Robert) Watson-Watt, with both of whom I had had the fortune to collaborate years before in the measurement of the strength of transatlantic radio signals or of the level of static interference.

Equipment used in the cross-Channel microwave link in 1931
By courtesy of the *Electrical Review*



The demonstration was, for the most part, the work of members of The Institution. Particular mention should be made of Dr. E. M. Deloraine, whose pioneering vision had inspired it, and of Mr. Clavier, the key-man of the team of scientists whose researches had made it possible. Other members of The Institution who contributed to the success of the demonstration were Mr. R. E. Gray and the late Mr. W. T. Gibson.

If I were asked what stands out most vividly in my mind in connection with those early cross-Channel experiments, I think, to be truthful, I should have to confess that it was the violence of the winds on the cliffs above Calais: how surprised were the engineers who arrived on site one morning after a violent storm to see the whole of their huts bumping about the plain miles away! On the technical side stands out the first enunciation of the principle of velocity modulation. For this we are indebted to Mr. Clavier, who explained thereby the hitherto obscure Barkhausen and Kurz and other microwave oscillations. He published his theory in *Electrical Communication* for July 1933.

I remember the effort applied to the determination of the most satisfactory radiator of microwaves: there were experiments with dielectric lenses and zone plates; there was a mathematical study of paraboloids and practical confirmation of the results of the study. The paraboloidal mirror finally chosen is in use with very little change even to-day in many commercial microwave links throughout the world. How important has the microwave art become for both military and civil purposes since that March morning in 1931.

SHORT REVIEWS OF PAPERS

On the following pages are some brief articles based on, and written by the authors of, current Institution papers. The authors have been asked to make these articles, so far as possible, of appeal to electrical engineers who have no specialized knowledge of the subjects, and the content of the articles is not necessarily confined to the subject-matter of the original papers.

A New On-Off Servo Mechanism

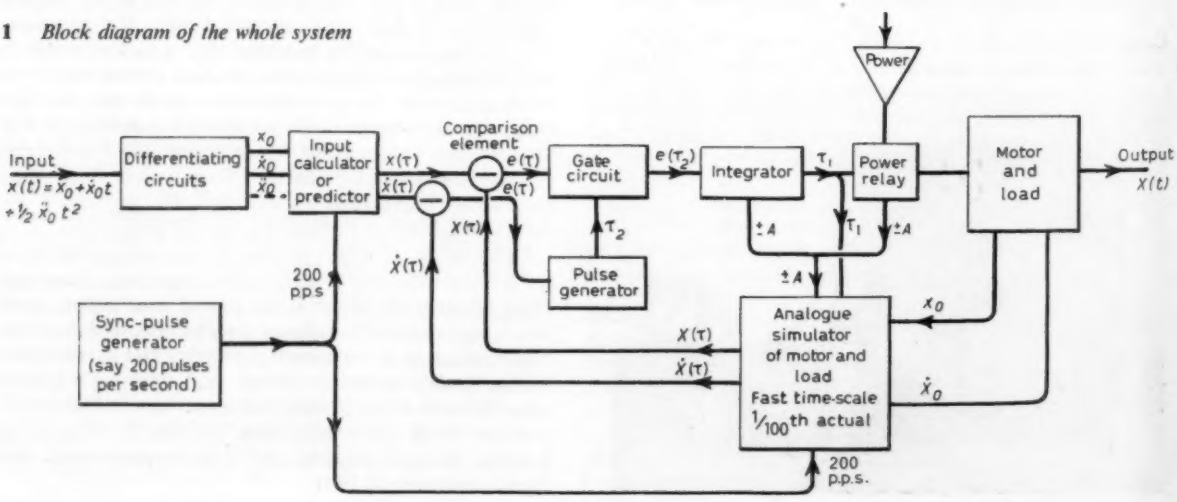
A short review of a Measurement and Control Section paper (No. 1895) entitled 'An On-Off Servo Mechanism with Predicted Change-Over', by J. F. Coales, O.B.E., M.A., Member, and A. R. M. Noton, B.Sc., Graduate. The paper was published individually in August, 1955, and it is republished this month in Part B of the Proceedings.

THIS PAPER DESCRIBES THE FIRST PART OF A PROGRAMME of research into on-off controls. Although the work could apply to most branches of automatic control the paper is written mainly with servo mechanisms in mind, i.e. it covers position control using, say, an electric motor. In this sense 'on-off' implies that the torque applied to the motor is switched from positive to negative or vice versa. On-off controls are attractive for two reasons: first, the performance should be better than the corresponding linear system which saturates at the same value of torque, because the maximum available torque is always used, and secondly with high-power controls the rotary amplifiers (metadynes) used in proportional servo mechanisms are eliminated.

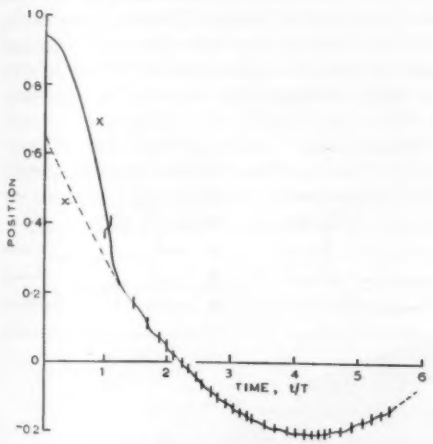
Hitherto, on-off or relay controls have been actuated on the appearance of an error (input minus output), often regardless of the characteristics of the motor and load. However, some work has been done on the correct switching of simple systems for step inputs by using a non-linear feedback network, but it becomes quite impracticable to realize the networks required to deal properly with more complicated motor and load characteristics and with random inputs. To meet this need a method has been devised for giving correct switching with almost any kind of motor and load likely to be encountered in practice for either transient or random inputs. The operation of such a system is explained with reference to Fig. 1. It is assumed that the switching of an on-off control should be such that error and rate of change of error are brought simultaneously to zero in the least possible time, and it can be shown that this is always possible with only one change-over.

The requisite initial conditions are: the present values of the position X_0 and velocity $\dot{X}_0$ of the motor and load and an estimate of the time ahead T_1 (τ_1 on the fast time scale) when change-over should occur. This information is fed into the repetitive computer, or simulator, and the differential equation of motor and load is solved on a fast time-scale, say, 200 times per second, giving a computed future position $X(\tau)$ and velocity $\dot{X}(\tau)$. At the same time, depending on the input information, a prediction is obtained of future position

1 *Block diagram of the whole system*



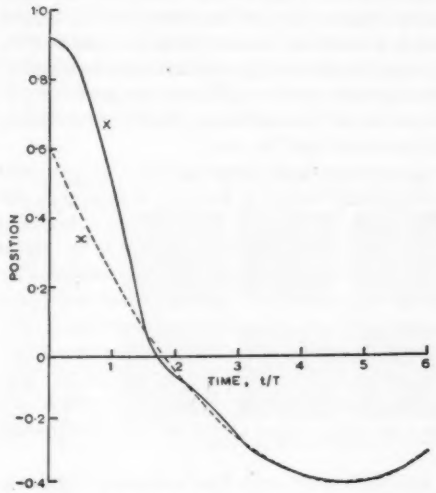
$x(\tau)$ and velocity $\dot{x}(\tau)$ on the fast time scale. From these waveforms are obtained the expected values of error $e(\tau)$ and rate of change of error $\dot{e}(\tau)$ from now until several seconds ahead, but on the fast time-scale. A 'guess' at the time ahead τ_1 when change-over should occur has been used to generate these waveforms. Now in each computing sweep, when the error rate $e(\tau)$ is zero, i.e. at time τ_2, a pulse is generated which operates a gate circuit to pass the value of the error at that moment $e(\tau_2)$, and, depending on the sign of this pulse (positive or negative) and on the present state of the power relay, the time ahead τ_1 when change-over must occur is either increased or decreased. In the next computing sweep a value of the estimated time to change-over will be used which will make $e(\tau_2)$ smaller, and so on. After a few sweeps the time to change-over has been adjusted to make $e(\tau_2) = \dot{e}(\tau_2) = 0$, i.e. the error and the rate of change of error simultaneously zero. This operation of adjusting the estimated time to change-over to the required value is going on continuously and with a time-lag negligible compared with the time-constants of the motor and load. When the computed time to change-over becomes zero the actual switching occurs, and the sequence is repeated until the next change-over, and so on.



2 *Response of on-off control to transient parabolic input*

The paper describes an experiment in which such a computer is used to switch the torque to a motor and load having inertia and viscous and Coulomb friction. As an example of performance the response to a parabolic input is shown in Fig. 2, in which the vertical lines indicate torque reversal.

In order to assess the value of this on-off servo mechanism a tentative comparison has been made with a similar system which uses linear control and which saturates at the same value of torque as the on-off system. For comparison with Fig. 2 the response of this system to a parabolic input is shown in Fig. 3. The settling time from step inputs was adopted as the standard of comparison, and the parameters of the orthodox servo mechanisms were adjusted to minimize this quantity. Comparison showed that on the average the settling time of the on-off control was about two-thirds that of the



3 *Response of orthodox servo mechanism to transient parabolic input*

linear, saturating control. In other words the same performance would be obtained with both systems by using only half the torque in the on-off control. In a control system of about 50 h.p. this saving in torque may well justify the complications of the electronic computer.

621–526

A New Resistance Wire

A short review of a Measurement and Control Section paper (No. 2084) entitled 'Nickel–Chromium–Aluminium–Copper Resistance Wire', by A. H. M. Arnold, Ph.D., D.Eng., Associate Member. The paper is published this month in Part B of the Proceedings.

TWO TYPES OF RESISTOR MAY BE CLEARLY DISTINGUISHED in engineering work, that which is designed to have a constant resistance and that which is designed to have a resistance which varies according to the values of certain operating conditions, such as voltage, temperature or current. The paper is concerned entirely with the first type.

The pure metals are unsatisfactory as resistors of the first type since their resistance varies several parts in a 1 000 for each degree Centigrade change of temperature. Fortunately, when pure metals are alloyed together the resultant alloy has characteristics differing markedly from the parent metals. The resistivity is usually much

higher and the change of resistivity with temperature, or more shortly the resistivity temperature coefficient, is greatly reduced. As soon as this fact was appreciated an intensive search was made for alloys with small resistivity temperature coefficients, and about 1888 Edward Weston discovered that the alloy of 60% copper and 40% nickel, known in this country as constantan, had a small negative resistivity temperature coefficient, that is of opposite sign to the coefficient for pure metals. By small variations of composition it was possible to get the coefficient very near to zero.

Although this represented a great advance, it was soon found that constantan was not entirely satisfactory for constant-value resistors, since a thermal e.m.f. between constantan and copper appeared, amounting to about 40μV per degree Centigrade difference of temperature between the two junctions. This difficulty was overcome with the development of manganin, 84% copper, 12% manganese and 4% nickel, which has a thermal e.m.f. to copper of only 2μV per degree Centigrade. The national standards of resistance in this country, the United States and many other countries are constructed of manganin.

However, although some very fine resistance standards of manganin have been made, notably by Otto Wolff, this material is not entirely satisfactory for all purposes. It is difficult to control the composition and heat treatment to ensure that the resistivity/temperature coefficient is zero at the working temperature, and the resistance is sometimes unstable owing to physical changes in the body of the alloy or chemical changes on the surface. The surface changes are particularly troublesome in resistors of high value which are wound with fine wire. There is one further drawback to manganin. The resistivity/temperature coefficient changes fairly rapidly with temperature, so that even though the coefficient is zero at one temperature it is not zero at another. This is of little importance for national standards which are operated under closely controlled temperature conditions, but it may be a serious drawback for commercial resistors, subject to appreciable ambient temperature changes and often operating with a high temperature rise due to the working current.

A new alloy with some striking properties has recently been developed having a composition of approximately 73% nickel, 21% chromium, 2% aluminium and 2% copper. The resistivity/temperature coefficient may be reduced to zero by a simple heat treatment after wire drawing. The change of the coefficient with temperature is only one tenth that of manganin, and its thermal e.m.f. to copper is at least as small as that of manganin. Its resistivity is three times that of manganin, so that it is especially suitable for resistances of high ohmic value. It appears to be fairly resistant to surface changes and it is possible to draw it down to diameters of 0·001 inch and less.

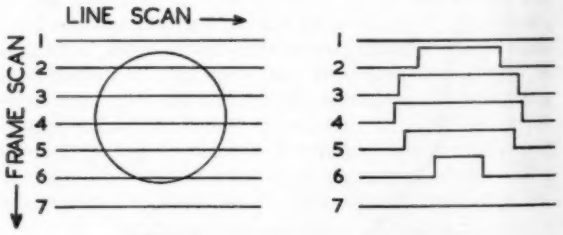
A number of resistors of this material have been constructed at the National Physical Laboratory with resistances from 1 ohm up to 10 megohms. Stabilities better than one part in 100000 per year have been obtained. The resistors can be operated with temperature rises of over 100° C.

It seems likely that this material may be superior to manganin for high resistances and possibly for all values, but its resistivity is liable to change when it is subjected to vibration, so that precautions should be taken to avoid this possibility. 621.315.5 : 621.316.8 : 669.018 : 389.16

Electronic Scanners

A short review of a Measurement and Control Section paper (No. 2053) entitled 'An Electronic Machine for Statistical Particle Analysis', by H. N. Coates, Ph.D., B.Sc.(Eng.). The paper is published this month in Part B of the Proceedings.

THE TECHNIQUE OF SCANNING BIOLOGICAL SLIDES, MICROphotographs, drawings or other two-dimensional representations of object profiles is now well established. Fig. 1(*a*) shows an object being scanned by such a system, and Fig. 1(*b*) the electrical signals obtained as the scanning spot traverses the object. The existence of this information in the form of two-state electrical impulses enables a rapid assessment to be made of factors relating to the profile shape of natural or manufactured objects.



1 *Principles of object scanning*
(*a*) Scanning process. (*b*) Electrical signals obtained.

The signal intercepts are fed into a computer which is arranged to recognize and collect the intercepts associated with each individual object, and to extract from these any particular feature of the object about which information is required. The maximum intercept length and the total number of intercepts associated with an object give its maximum dimensions in two directions, while the sum total of intercept lengths multiplied by the line spacing gives the projected area of the object. The speed at which the computer works makes statistical analysis of large numbers of objects an attractive proposition.

The paper is concerned with the operation and circuit details of the computer, which has been designed to give maximum flexibility in the choice of scanning speeds and

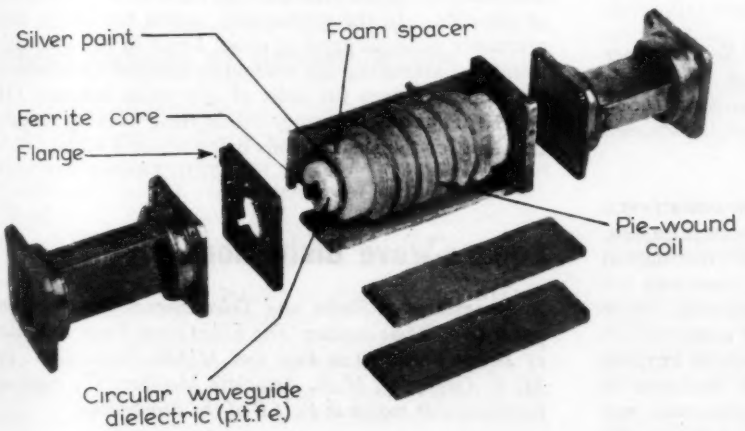
to tolerate non-linearity and drift in the scan generators. This is achieved by using the output from the line-scan generator as a reference source for the location of an intercept along the direction of scan, and by using the output from the frame-scan generator to anticipate the arrival on the next line of a further associated intercept. The circuit is so arranged that this anticipation is greatest on the second intercept of a group associated with an object. 621.374.32 : 621.389 : 620.113

A Microwave Modulator

A short review of a Radio and Telecommunication Section paper (No. 2061) entitled 'A Ferrite Microwave Modulator employing Feedback', by W. W. H. Clarke, Ph.D., B.Sc., Associate Member, W. M. Searle, M.Sc., and F. T. Vail, B.Sc. The paper is published this month in Part B of the Proceedings.

THE USE OF MAGNETIC MATERIALS HAS BEEN EXPANDING and in recent years ferromagnetic materials have appeared having low losses at microwave frequencies. These are principally ferrites. Engineers have been quick to apply the non-reciprocal and controllable propagation which occurs when magnetic bias is applied to such gyromagnetic material in a waveguide. When the magnetic bias is longitudinal the non-reciprocity takes the simple form of the Faraday effect; variation of the magnetic bias can provide a modulator capable of rapid response yet independent of the microwave signal source.

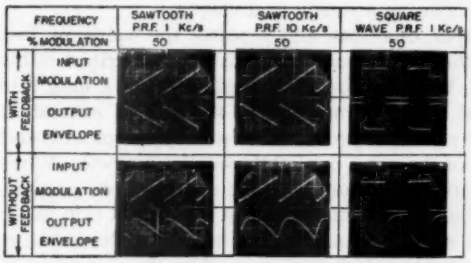
Fig. 1 is an exploded view of such a modulator, with



1 *Ferrite microwave modulator*

a thin guide wall to permit efficient coupling of the externally applied field to the ferrite at high frequencies. In principle, cross-polarized waveguides as shown allow the unmagnetized modulator to produce infinite insertion loss, while the magnetization giving 90° Faraday rotation produces no insertion loss. Between these limits a non-linear modulation characteristic exists. The magnetization lags on the coil drive voltage owing to inductive delay, eddy-current delay (in the guide wall), and hysteresis.

The paper describes how feedback has been applied to minimize these defects with this type of modulator, using linear detection of the output microwave signal. The difference between the detected signal and the required



2 *The effect of feedback on non-sinusoidal functions*

modulation envelope is used for the modulator drive. Owing mainly to the noise factor of the linear detector, it was found necessary to restrict the amplifier bandwidth below the modulator response in order to employ a loop gain of 50 dB. The paper tabulates harmonic sideband levels for 25%, 50%, 66% and 75% sine-wave modulation at 1 kc/s, and for 25% and 50% modulation at 10 and 20 kc/s. Harmonic suppression by some 40 dB is a representative figure from these tables.

The feedback performance is best illustrated by non-sinusoidal functions as shown in Fig. 2. 621.376.22 : 621.318.134

Thermal Resistivity of Soil

A short review of a Measurement and Control Section paper (No. 1942) entitled 'An Evaluation of Two Rapid Methods of assessing the Thermal Resistivity of Soil', by M. W. Makowski, Dipl.Ing., Associate Member, and K. Mochlinski, Dipl.Ing., Associate Member. The paper was published individually in December, 1955, and it will be republished in Part A of the Proceedings.

THE PERMISSIBLE LOADING OF CABLES IS FIXED BY LIMITING conductor temperatures, and thus, for continuously loaded cables laid in the ground, largely by the thermal resistivity of the soil. Soils of thermal resistivity as low

as 60 thermal ohm-cm or as high as 300 thermal ohm-cm are not uncommon, and the carrying capacity of a cable may be twice as great in the former soil as in the latter. If, therefore, the capabilities of cables are to be fully utilized without risk of overheating, the thermal resistivity of soil along cable routes must be determined. With the increasing desire to utilize cables more fully than in the past, there has arisen a need for a more rapid method of assessing the thermal resistivity of soils than that, used hitherto, of deriving it from the steady-state temperature of the surface of a buried metallic sphere or cylinder enclosing a steady heat source.

The paper describes and assesses the value of two rapid methods developed from methods described in the literature. With the first, the *needle method*, a long thin cylindrical heater is inserted in the soil of interest, if necessary after first preparing a hole by means of a stiff pilot rod of the same or slightly smaller diameter. When temperature equilibrium with the soil has been reached, energy is supplied to the heater at a constant rate. After an initial starting transient the increase of temperature of the heater becomes proportional to the logarithm of time elapsed from the start of heating. For a heater dissipating q watts/cm, if θ_1, θ_2 are temperatures in degrees centigrade at times t_1, t_2 sec, the thermal resistivity g is given by:

$$g = 4\pi (\theta_2 - \theta_1)/q \log (t_2/t_1) \text{ thermal ohm-cm.}$$

The second method, that of *soil sampling*, is applicable only to soils of clay or sand or a mixture of these, and relies on the fact that the thermal resistivity of soil depends on the thermal resistivity of its constituent materials, on the degree to which they are compacted, and on the moisture content. A sample of the undisturbed soil is taken, and its moisture content, dry density, and the relative proportions of clay and sand are determined by a suitable analysis. From these characteristics the thermal resistivity may be calculated or read from a nomogram.

An account is given of the application of each of these methods, and the results are compared with those obtained by the use of a heated sphere. It is concluded that the three methods used in the field give results which agree broadly to within $\pm 10\%$, a performance which is tolerable for the purpose. Both rapid methods permit several observations to be made in the course of a normal working day. The needle is less robust than is desirable for field use; improvement in this respect is possible at the cost of a longer time for each observation. Caution must be used in applying the soil-sampling method to soils with which the operator is unfamiliar. Experience gained by the use of the two methods simultaneously should permit the satisfactory application of either of them alone for routine measurements.

550.372

SYNOPSES OF PAPERS

The following are synopses of papers published in the *Proceedings* without being read at an Institution meeting which have not been described elsewhere in the *Journal*.

R. F. Inductance

A synopsis of a Measurement and Control Section paper (No. 2080) entitled 'The Calibration of Inductance Standards at Radio Frequencies', by L. Hartshorn, D.Sc., Member, and J. J. Denton, B.Sc. The paper is published this month in Part B of the Proceedings.

THE PRECISION WITH WHICH STANDARDS OF INDUCTANCE can be measured and used at radio frequencies is limited, not only by the ordinary uncertainties of experimental technique, but also by the fact that the standards are necessarily circuit elements with terminations, while inductance is primarily a characteristic of complete circuits. The procedure followed at the National Physical Laboratory when the highest possible precision is required is described in both its experimental and theoretical aspects. The precise relation between the familiar equivalent network for a coil and the basic definitions is indicated, and practical details are given for the resonance method of measurement that has been adopted as standard practice for all work of this kind. It is successfully operated at all frequencies from the audio range, where it overlaps the bridge methods employed as standard practice in the lower ranges of frequency, to values little short of those of self-resonance of the coils. In the overlapping region the bridge and resonance methods agree to about 1 part in 10^4, and with suitable elaboration the resonance method gives about the same accuracy for coils of any value between 1 H and 10 μH at any frequency within their working ranges, the limit for the smaller coils being about 4 Mc/s.

621.317.334.089.6 : 621.3.011.3

Square-Wave Distortion

A synopsis of a Radio and Telecommunication Section paper (No. 2098) entitled 'The Effect upon Pulse Response of Delay Variation at Low and Middle Frequencies', by M. V. Callendar, M.A., Associate Member. The paper is published this month in Part B of the Proceedings.

CALCULATIONS ARE GIVEN FOR THE MAGNITUDE AND FORM of the distortion introduced into a square wave by a network or system which exhibits uniform transmission except for increasing (or decreasing) phase delay in the low-mid-frequency region. The fractional peak distortion is found to be equal to twice the area under the curve relating T_n to frequency, where T_n is the delay relative to

that at high frequencies. The waveform of the distortion is given for several simple shapes of curve for T_n. This distortion is especially characteristic of vestigial-sideband systems, and occurs in television as a 'pre-shoot' before a transition and as a smear (in principle equal, but opposite, to the pre-shoot) after it.

621.372.4/.5 : 621.391 : 621.3.018.78

Wide-Band Noise Sources

A synopsis of a Radio and Telecommunication Section paper (No. 2060) entitled 'Wide-Band Noise Sources using Cylindrical Gas-Discharge Tubes in Two-Conductor Lines', by R. I. Skinner, B.E. The paper is published this month in Part B of the Proceedings.

THE PROVISION OF WIDE-BAND NOISE SOURCES FOR THE decimetre wavelength region is important for many radio applications. A noise signal of suitable power level for most purposes is obtained when the plasma region of a gaseous discharge is matched to a transmission line.

Examination of the properties of a discharge plasma shows that a noise source with an output which is constant over several octaves can be obtained by matching a cylindrical discharge tube directly to a two-conductor line. Such matching can be achieved by using conductor pairs of various shapes. The factors which affect the operation of the matching element are considered, and a practical design procedure is outlined.

These noise sources are simpler to construct and of better performance than those used previously at decimetre wavelengths. 621.387 : 621.372.43

Phase Change of Ground Waves

A synopsis of a Radio and Telecommunication Section paper (No. 2082) entitled 'Change of Phase with Distance of a Low-Frequency Ground Wave Propagated across a Coast-Line', by B. G. Pressey, M.Sc.(Eng.), Ph.D., Member, G. E. Ashwell, B.Sc., and C. S. Fowler. The paper is published this month in Part B of the Proceedings.

OBSERVATIONS OF THE CHANGE OF PHASE WITH DISTANCE have been made on a frequency of 127·5 kc/s along a number of paths radiating from a transmitter near Lewes and crossing the south coast between Pevensey and Littlehampton. The nature of the ground adjacent to the coast, the angle of crossing the coast-line and the lengths of the land and sea sections covered varied from path to path; the greatest distance covered out to sea was 22 km.

The results confirm the existence of a phase-recovery effect predicted from theoretical considerations, and show that, in addition to this general behaviour of the phase, there are superimposed systematic variations whose magnitudes decay from about 4° of phase near the coast to a negligible amount at 6λ out to sea and on some paths are comparable to the recovery. A very marked phase disturbance within $\lambda/2$ of the coast on the landward side is also evident, similar to that previously observed over geological boundaries on land.

621.396.11

Deviation of Ground Waves

A synopsis of a Radio and Telecommunication Section paper (No. 2083) entitled 'The Deviation of Low-Frequency Ground Waves at a Coast-Line', by B. G. Pressey, M.Sc. (Eng.), Ph.D., Member, and G. E. Ashwell, B.Sc. The paper is published this month in Part B of the Proceedings.

AFTER CONSIDERATION OF THE METHODS WHICH HAVE been suggested for computing the deviation of ground waves at a coast-line, the phenomenon is re-examined in the light of recent experimental and theoretical work on the phase disturbances at such a boundary. It is shown that the deviation may be calculated from the rate of change of phase with distance along the path of propagation. The changes in this rate which occur at the boundary give rise to a considerable increase in the magnitude of the deviation as the receiving apparatus is brought within a few wavelengths of that boundary. This increase near the coast seems to provide an explanation of the unexpectedly large deviations previously observed at medium frequencies.

A series of simultaneous measurements of the phase change and the deviation along a number of paths crossing the south coast of England are described. Although general agreement between the measured deviations and those derived from the phase curves was obtained on some paths, there were appreciable discrepancies on others. These discrepancies are attributed to the irregularities in the phase surface which were evident over the area and which the method of derivation did not take into account. 621.396.11

Atmospherics

A synopsis of a Radio and Telecommunication Section paper (No. 2099) entitled 'The Propagation of a Radio Atmospheric', by C. M. Srivastava, M.Sc. The paper is published this month in Part B of the Proceedings.

ON THE ASSUMPTION THAT THE SPACE BETWEEN THE EARTH and the ionosphere acts as a waveguide, the mechanism of propagation of an atmospheric has been considered from the viewpoint of plane-wave reflections. The pulse at the origin has been assumed to be rectangular and of duration 100 microsec. It has been possible to give a physical picture of the mechanism and to explain the oscillatory waveform of distant atmospherics.

621.396.11 : 621.396.821

The Choice of Generating Plant in Nigeria

A Condensed Version of a Paper by K. H. Widgery, B.Sc., Associate Member

A discussion of the choice of generating plant, with particular reference to its suitability for use in Nigeria, was given in a paper by Mr. Widgery that was read before the West Africa Joint Oversea Group last year. The article that appears here is a much condensed version of the original paper. Mr. Widgery lists the general conditions governing the choice of generating plant and comments on the various types of prime mover, and he examines the choice between steam turbines and Diesel engines in some detail.

General Requirements

WITH the exception of the extensions to the Ijora B Power Station, the rating of the generating sets which are envisaged for use in Nigeria in the next ten years or so is considerably less than 30 MW, which is the smallest standard rating used by the Central Electricity Authority. Consequently the conditions governing the choice of the type of prime movers to install in power stations in Nigeria are very different from those obtaining in the United Kingdom, where, in general, the steam turbine is the only suitable machine. The choice in Britain is a matter of the size of the set, which may be rated at 120 MW or more, the degree of super-heating, the pressure to be used, and the method of firing the boiler—pulverized coal, oil or nuclear energy. This is made possible by an extensive interconnected system with its demand for large generating units, and by an adequate pool of highly skilled engineers and technicians for operating and maintaining the plant. These do not exist in Nigeria at present, and although some interconnection may be introduced in a few years, it will be a long time before the loads required justify the installation of power stations that would be modern by British standards. The problem is, therefore, one of a series of independent stations, and is different for each of them, depending mainly on the magnitude of the load and the relative prices of coal and oil.

The main considerations affecting the choice of plant are: the capital cost arising from it, the annual interest, loan amortization and depreciation charge; maintenance costs; the annual cost of salaries and wages for the operating staff; the annual cost of fuel; the size of the individual sets and the ultimate size of the station; the operational flexibility which can be achieved with the plant chosen; the availability of cooling water; and the accessibility of the site.

The Types of Plant Available.

Hydro-electric Stations. If adequate proved water resources are available and the cost of the necessary civil engineering works is not prohibitive, hydro-electric stations may show a considerable advantage over other methods of generation. They are simple mechanically; they need a small operating staff, or can be run completely by remote control; fuel costs are non-existent, and they make no demand upon irreplaceable energy resources. Unfortunately in Nigeria they suffer from a number of disadvantages:

(i) Effectively no adequate hydrological data is available at present. Accurate records over a period of at least thirty-five years are normally considered necessary before constructing a hydro-scheme.

(ii) With the seasonal nature of the rainfall, considerable storage is required. The stations in Nigeria at Kurra and Jekko on the edge of the Bauchi Plateau have in fact over eight months' storage available. But the country is, in general, flat and the provision of the necessary storage entails inundating considerable areas of land and constructing extensive dams.

(iii) Potential sites are remote from the areas where there is a demand for electricity, and the cost of transmission outweighs the saving on fuel. Furthermore the difficulty in staffing such remote stations would be considerable.

Steam Stations. These can be divided into: (*a*) steam reciprocating engines; and (*b*) steam turbines.

A subdivision can be made according to whether the heat intake to the boilers is from wood, coal, oil, natural gas or nuclear power.

Steam reciprocating engines are comparatively simple to operate, and have given good service in some of the older power stations in Nigeria. However, they are not efficient, and in the sizes in which they are competitive with the steam turbine, up to about 750 kW, are not as attractive as the Diesel engine with normal fuel costs in Nigeria.

Steam turbines are the main form of prime mover used for power generation, being simple mechanically, giving a uniform torque, and having a reasonably high efficiency. The efficiency decreases as the size of the turbine decreases, and below about 750 kW they have little advantage over the reciprocating engine.

Wood firing of boilers might appear to be advantageous, especially in the southern part of the country where wood is apparently abundant. However, except where it

is available in quantity as a waste product from manufacturing operations, it has many disadvantages. It is variable in quality, and in the quantities required for firing a power station—up to 300 tons per day for a 10 MW station—the organization of the supply of the wood is difficult and leads to endless arguments with contractors on quantities and prices. It has been found that wood prices rise steadily, and on a B.t.u. basis, coal is competitive.

Coal firing of boilers has, to date, been the standard method used in Nigeria. Coal has the advantage that it is an indigenous fuel, but it is no longer cheap; in addition it needs considerable handling equipment in transporters, crushers, elevators and bunkerage in the power-station building; it needs special grates with their associated demand for auxiliary power and maintenance problems; it needs ash-handling plant, and with a coal having an ash content of up to 30%, ash disposal on a large station such as Ijora B is no small problem. Furthermore, the price of coal varies with very little notice and its quality is not guaranteed.

Oil firing of boilers is common practice in many parts of the world. It has many advantages over coal firing; it is simpler to handle, is cleaner, and requires a less complicated boiler, no ash-disposal plant and no overhead bunkerage in the power-station building. One great advantage over coal is that it is sold to a guaranteed specification of, say, 10000 B.t.u./lb and there is no room for doubt as to the quantity of oil and the amount of heat energy delivered for a stated sum of money. Furthermore, there are a number of firms who are prepared to tender for the supply of oil fuel, and this helps to ensure that the price is kept as low as possible. It has the disadvantages that combustion control is more difficult than with a chain-grate boiler using coal, and that the gas leaving the furnace is rich in sulphur.

The use of nuclear power for steam raising in power stations is still in its development stages. It seems probable that an increasing amount of the world's power will in the future be met by stations using nuclear fuel, but the date when such stations will become a proposition in Nigeria probably lies well ahead.

Stations powered by Internal Combustion Engines. There are three main types of internal combustion engines used in power stations:

(*a*) Diesel engines.
(*b*) Gas engines and dual-fuel engines.
(*c*) Gas turbines.

(*a*) Diesel engines are the main alternative to steam turbines as prime movers for power generation in Nigeria. Their initial cost is relatively low, and their thermal efficiency high, but they are expensive to maintain. For small sets they are far more economic than the steam turbine, and, depending upon relative fuel prices, they may be competitive for sets of ratings up to about 2000 kW. The advantages and disadvantages of the Diesel engine vis-à-vis the steam turbine are discussed below.

(*b*) Gas engines and dual-fuel engines, operating on producer gas manufactured from wood or coal, are competitive with Diesel engines up to about 1000 kW, provided that adequate supplies of suitable fuel are available, and that fuel costs are in their favour. They suffer from considerable disadvantages in that extensive gas purification plant is essential to avoid carrying over tar and dust into the cylinders, with consequent heavy maintenance costs. Past experience has shown that although on paper they may be a slightly better proposition than Diesel engines, they are a constant source of trouble to the operating engineers. If wood fuel is used gas engines suffer from the same supply problems as do wood-fired boilers. This is overcome in part by the dual-fuel engine, which will operate either as a gas engine or as a Diesel engine, but it is more expensive initially.

(*c*) Gas turbines have, in the smaller sizes, a higher initial cost and lower efficiency than Diesel engines, but in the larger sizes, up to 25000 kW, they may well be competitive with steam turbines. They have the advantage of being considerably lighter and occupying less building space than steam-turbine installations with a similar output. They have a further advantage in that comparatively little cooling water is required, and in some locations this could be an overriding consideration. To the supply engineer their main disadvantage is the paucity of operating experience on them, and it may well be some years before they can be seriously considered for power stations in Nigeria.

The Choice between Steam Turbines and Diesel Engines: 2250–15000 kW Stations

The choice between steam turbines and Diesel engines is the main one for Nigeria at the moment, and the factors affecting it are examined below. The limits of 2250 kW and 15000 kW are taken because, below 2250 kW installed capacity, steam-turbine plant has a very high initial cost per kilowatt and a relatively low efficiency. Above 15000 kW installed capacity the lower cost per kilowatt and the relatively higher efficiency of the larger turbines are in their favour, while the greater number of Diesel sets required to provide the capacity, with the consequent operating and maintenance problems, are against the use of Diesel plant.

Capital Cost and Annual Capital Charges. The initial cost of steam-turbine-driven alternators with their associated boilers and auxiliary plant is considerably higher than for the equivalent capacity in Diesel plant, being approximately twice as high for a station with an effective capacity of around 10000 kW and over three times as high for one with an effective capacity of around 1500 kW. A station with three 5000 kW turbo-alternators may cost around £100/kW, and a station with twelve 1300 kW Diesel sets around £50/kW. These prices are purely indicative of magnitudes: actual costs will depend upon the type of set, the site, the building, etc.

Interest rates and loan amortization charges will be the same for Diesel engines and steam turbines, but it is necessary to charge depreciation on Diesel plant at about twice the rate of that used for steam-turbine plant. Despite this the total charge for interest plus amortization plus depreciation will normally be higher on a steam station than on a Diesel station of the same capacity.

Maintenance Costs. In general, the maintenance of steam-turbine plant is much less costly and far less complex than that of Diesel plant. Not only is the number of moving parts less, but their motion is, for the most part, rotary rather than reciprocating and consequently they are less subject to shock loading. The maintenance of Diesel plant entails relatively frequent overhauls, all of which require skilled staff, whereas apart from a biennial 'look inside' the only routine maintenance called for on a turbine is condenser cleaning which can be carried out by semi-skilled staff. Maintenance of auxiliaries is more complex for a steam-turbine installation, in that there are more auxiliaries than for a Diesel installation, though this becomes less true as the size of the installation increases. Maintenance of four Diesel engines is almost exactly four times that of one, assuming the same plant utilization factor, but two steam-turbine installations with sets of, say, 1000 kW and 5000 kW will require approximately the same amount of maintenance.

Comparison of maintenance costs is difficult in that the cost of Diesel engine maintenance will depend upon:

(*a*) The type and speed of the sets.
(*b*) The standard of the operating personnel.
(*c*) The standard of the maintenance personnel.

The first consideration is one which can be controlled only when the sets are ordered, though shortage of capital may necessitate the purchase of the cheapest plant available, regardless of its future maintenance problems. With the operating and maintenance staff available in Nigeria there is no doubt that the reduction in maintenance costs with simple and robust plant will offset the possible slight reduction in efficiency, and the slight increase in capital charges. Nevertheless, under Nigerian conditions it is doubtful whether the maintenance costs on Diesel plant can be brought down to less than twice those on steam plant of the same capacity.

A further consequence of the increased routine maintenance of Diesel plant as against steam plant is that the availability of Diesel plant is considerably lower than that of steam plant.

The Annual Cost of Salaries and Wages. The operating staff required for a Diesel station is considerably less than that required for a steam station. In a Diesel station it is necessary to man only the switchboard and the engine room, whereas in a steam station it is necessary to man the boiler room and pump house as well, and to provide coaling and ash-handling gangs. The relative costs are more in favour of steam for larger sizes of station, since the staff of a Diesel station increases with the number of sets but the staff of a steam station does not vary appreciably with the size of the steam turbines.

Annual Cost of Fuel, Lubricating Oil and Make-up Water. This is the major component of the annual cost of operating a power station. Its total effect will depend largely upon the type of duty which is required of the plant: for plant which is to be used for base-load purposes it is worth paying more to obtain the highest possible thermal efficiency, but for plant which is required for peak-load or stand-by purposes there may well be grounds for saving on capital cost at the expense of efficiency.

The Ultimate Size of the Station. In general if a station is ultimately expected to grow beyond an effective capacity of about 10 MW, the advantage lies with steam turbines rather than Diesel engines because:

(i) It pays to install a few large sets rather than a multiplicity of small sets, in that the station, having less auxiliary equipment in it, is simpler to operate and maintain and requires less staff.

(ii) As the size of a turbo-alternator increases so does its thermal efficiency, whereas above about 1000 kW the thermal efficiency of a Diesel engine does not vary greatly.

(iii) With large turbines employing larger boilers, higher pressures and temperatures become practicable, and more automatic control and mechanical coal- and ash-handling may be used.

Operational Flexibility. With any type of plant the method of operating depends upon:

(*a*) The varying load through the day.
(*b*) The efficiency of the plant over 0–110% of its full-load rating.
(*c*) The ease with which it can be brought into operation from scratch.

The steam turbine has the advantage of a far flatter efficiency-load curve than the Diesel engine, which has a relatively peaky curve, with the efficiency falling rapidly below about 75% full load. Moreover, if the load is such that steam sets can be kept running continuously the plant can operate with a higher efficiency than it can if the load is such that sets have to be shut down and boilers banked. With a larger number of Diesel sets, which consume no energy when shut down, the efficiency of operation on a peaky load is not far short of that of operation on a steady load.

Delivery of Plant. Where it is essential to put new plant into commission as soon as possible, Diesel plant has a decided advantage over steam plant, largely because of the time taken by the extensive civil engineering works required for a steam station. In addition, delivery dates from Diesel manufacturers are often better than those offered for steam plant.

Availability of Cooling Water. In places where water is scarce, as it is in the north of Nigeria, the Diesel engine has a great advantage over steam plant, the make-up

required for cooling ponds being only some 10–15% of that required for a steam station. Furthermore, where shortage of water entails the use of cooling ponds or cooling towers, the initial cost of a steam station is increased.

Accessibility of the Site. Where access to the site by road and rail is difficult, the very heavy loads associated with larger steam plant may well make Diesel plant preferable. It is likely that this problem of moving heavy and large loads will limit the size of the sets which can be installed in Nigeria.

An additional point is that Diesel oil can be transported by road to places without a railway more easily than coal.

Conclusion

In choosing the type of plant to install in a power station, the fuel costs will, in general, be the overriding consideration. With a station generating up to 40×10^6 kWh per annum, a saving in fuel costs of a decimal of a penny per kWh means a considerable saving over the year, and will probably offset such additional capital charges as may be entailed in obtaining that saving. However, efficiency must be considered against the background of the other factors discussed above, and in particular, against the suitability of the plant for use with the labour available for its operation and maintenance. Highly efficient plant which spends a great deal of time out of commission owing to faulty operation and the inability of the maintenance staff to work to the close tolerances which are inherent in a highly efficient engine is far less satisfactory than simple and more robust plant, even if the latter is slightly less efficient. The modern high-speed supercharged Diesel engine is a very efficient piece of machinery provided that it has the right treatment. Whether, with conditions in Nigeria as they are now, it can be given such treatment and can be expected to have its rightful useful life is a question which has yet to be answered, whereas it is known that in Nigeria steam-turbine plant can be operated satisfactorily over long periods.

SOME RECENT BOOKS

C. F. MAYSON

LAW AND THE ENGINEER

CHAPMAN AND HALL. 490 PP. £3 3S.

This work fills an important gap, for while architecture and building have been well provided for by writers of legal textbooks, mechanical and electrical engineering have hitherto been Cinderellas in search of a legal Prince Charming.

As the author himself makes clear in his preface, any attempt by a lawyer to write a treatise so complete as to enable members of a different profession to dispense under all circumstances with qualified legal advice would be a fruitless and dangerous undertaking. Apart from an Appendix dealing with certain clauses of the standard conditions of contract of professional engineering and architectural bodies, which is of special interest to members of The Institution, Mr. Mayson has not attempted to deal in detail with the particular legal problems that beset engineers, but he has instead given a concise yet comprehensive statement of the law of contract and of negligence viewed from the standpoint of engineers, whether consultants or contractors, and preceded by an outline of the machinery of the law and of its development.

Indeed many readers will find this outline, which forms the first section of the book, the most interesting. In the space of thirty-five pages Mr. Mayson has provided a background which for clarity and liveliness it would be hard to better.

The remainder of the book follows substantially on ground well trodden by legal textbooks, except that the examples chosen by the author to illustrate principles are wherever possible taken from the sphere of engineering. The result is a compact handbook which covers every principle of law likely to be encountered by the engineer.

Such a work must necessarily omit much of the civil law that is essential for legal practitioners or students, but it is by no means devoid of interest to lawyers. Of particular interest is the author's bold attempt to resolve the inconsistency between the rules for remoteness of damage in contract and those applicable to tort. Briefly the classic doctrine is that the damages recoverable for breach of contract are such as may reasonably be supposed to have been in the contemplation of the parties, when they made the contract, as the probable result of the breach, while the damages recoverable in tort are those which flow directly from the tort, whether in the 'reasonable contemplation' of the tortfeasor or not. Mr. Mayson argues that the 'reasonable contemplation' test in practice applies also to tort, but even if his views enjoy some support from judges' dicta, its acceptance would mean the reversal of such established decisions as those of the *Polemis* case, *Dulieu v. White*, or *Hambrook v. Stokes*. To take the two last, it seems a little unreal to speak of it being in the 'reasonable contemplation' of a negligent driver that his victim may be a person suffering from a physical abnormality, or that a mother may see his lorry run away and suffer from shock as a result of fear for the safety of her children. But if Mr. Mayson oversimplifies one of the most confused problems of the law, it is only fair to add that he advances his argument with suitable diffidence. The result is to stimulate, rather than to mislead, his readers.

Any engineer intelligent enough to realize that this work is designed neither to allow him to dispense with proper legal advice nor to solve the tiresome legal minutiae which so frequently bedevil his business will see that business in much truer perspective after reading it. From the first section of it he will in addition obtain real entertainment.

P. F. R. VENABLES

TECHNICAL EDUCATION

BELL. 657 PP. £2 2S.

The man who is reputed to have said, on first seeing a camel, that it had obviously been designed by a committee, might justifiably feel that the British system of technical education could be the product of a large number of sub-committees with various terms of reference.

Even those who are intimately associated with one or another aspect of technical education cannot fail to be impressed by the immense complexity of the subject as revealed in this book, and by the skill with which Dr. Venables, Principal of the Royal Technical College, Salford, has marshalled his material. The author's experience in educational administration fits him admirably to undertake such a survey, but he has wisely delegated the task of dealing with certain branches of the subject to five fellow principals. Thus Engineering by Mr. C. L. Old, Building by Mr. D. A. G. Reid, Art by Mr. K. Holmes, Women in Further Education by Miss E. Hollings, and Commerce by Dr. E. Thompson, form five of the twenty chapters of the book.

These special chapters are preceded by a historical survey and a review of the current situation in technical education. This includes references to the character and range of institutions, illustrated by typical examples and supported by appendices giving full details of all British technical institutions, working arrangements, relationships with professional and other bodies and with industry, and the selection and placement of students.

The book is, however, more than a factual survey of the present state of technical education. Some of the most valuable chapters are those which deal with Freedom and Governance, Finance and Administration, Students' Needs and Problems, Staffing and Administration, and Buildings and Equipment. It is in these chapters particularly that the author reveals those intangible factors which can prevent a technological training being an education which 'enables one to gain those rewards in this life which it renders one incapable of enjoying'. It is his critical and sensitive appreciation of the wider significance of technical education and its impact on social and cultural movement that makes this book so valuable. In campaigning for a more liberal attitude the author is not unaware of the criticisms of narrowness which are often levelled at technical education. He writes, 'The stigma of the worst aspects of industrial civilization is . . . apt to be attached to technical education which has suffered a surfeit of epithets from those ensconced in ivory towers'.

Comprehensive as the book is, it suffers from the inevitable limitations imposed by the need to select illustrative material and by the continuing changes in much of the information given in tables and charts. The first is not important, for the selection of representative examples is well done. It is to be hoped, however, that provision will be made to bring the factual material in the book up to date after a convenient interval; the task of compilation has obviously been so great that it would be regrettable if the enduring values of the book were prejudiced by mere obsolescence of statistical information.

This is a book which should be read by all who are seriously interested in technical education. It should do much to widen the horizons and increase the awareness of those whose daily work in some branch of this great field may tend to restrict their vision and sympathies.

MONOGRAPHS AND PAPERS

published individually this month

MONOGRAPHS

A Study of the Field Distribution at an Axial Focus of a Square Microwave Lens

MONOGRAPH No. 186 M

P. A. MATTHEWS, B.Sc., and PROFESSOR A. L. CULLEN, Ph.D.

The field distribution near the focus of a microwave lens is studied both theoretically and experimentally.

The relation between vector field-diffraction theory and scalar field-diffraction theory is discussed for this particular problem, and it is shown that the principal component of the electric field can be evaluated with sufficient accuracy from the scalar theory. Measurements of the transverse component of the electric field have been made by a perturbation method using a spinning dipole. The experimental results are in good agreement with the theory.

The often-discussed phase-shift of 180° in the passage of a wave through the focal plane is considered in some detail and the related change in wavelength near the focus is verified experimentally.

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An Investigation of the Eddy-Current Anomaly in a Low-Silicon Sheet Steel

MONOGRAPH No. 187 M

H. ASPDEN, Ph.D., B.Sc.

The eddy-current anomaly effects in an 0·019 in thick low-silicon sheet steel are investigated and analysed on the basis of the magnetic inhomogeneity arising from ferromagnetic domain structure. This particular steel was chosen because previous experimental work had shown that inherent time-lag effects in the magnetization process were small. However, in such a steel, flux waveform distortion arising from hysteresis phenomena adds to the anomaly effect, and a special experimental technique by which such distortion effects could be eliminated from the analysis was developed. This made it possible to test the steel, focusing attention upon the anomaly effect attributable to the magnetic inhomogeneity of the steel. The results obtained are interpreted in terms of a hypothetical domain configuration, and it is concluded that the magnetic inhomogeneity arising from ferromagnetic domain structure does account for the eddy-current anomaly as found in the steel, distortion and time-lag effects being of minor importance.

The Measurement of Magnetron Frequency-Pulling

MONOGRAPH No. 188 R

J. R. G. TWISLETON, B.Sc.

The frequency pulling of an oscillating magnetron is measured by inserting a reactor in the output feeder, which produces a reflection of constant magnitude but variable in phase; the frequency pulling is usually estimated on the assumption of constant voltage-standing-wave ratio in the feeder. In practice, when multiple reflected waves exist in the feeder, the v.s.w.r. is not constant, but it is found that the amplitude/phase variation of the resultant reflected wave is such that the locus of the voltage reflection coefficient is a circle on the Smith chart. Assuming an idealized equivalent circuit for the magnetron, the author estimates the theoretical frequency-pulling. The performance of a typical waveguide system used in magnetron testing is examined with regard to the possible variation in measured frequency-pulling.

PAPERS

The Signal/Noise Performance Rating of Receivers for Long-Distance Synchronous Radiotelegraph Systems using Frequency Modulation

PAPER No. 2103 R; PART B

H. B. LAW, B.Sc.Tech.

Experimental results, supported by theory, indicate that the error liability after regeneration of the output of a limiter-discriminator frequency-modulation radiotelegraph receiver, when fed with steady signals plus noise, can be described in terms of a simple exponential relation involving a single parameter, which characterizes the receiver performance. This parameter, defined as the signal/noise energy ratio required to give an error liability of $1/2\varepsilon$, is also the amount by which the receiver falls short of the ideal in the non-diversity detection of Rayleigh-fading signals in noise. It is therefore a convenient index of performance. The losses entailed in diversity by selection as compared with ideal diversity combination, in the reception of fading signals, are determined for 2-, 3-, and 4-path diversity; they are small, but perhaps not insignificant. Test results suggest that the practice, at present almost universal, of specifying receiver performance in terms of telegraph distortion, with an allowance for associated line tails, causes an appreciable waste of channel capacity.

The Detectability of Fading Radiotelegraph Signals in Noise

PAPER No. 2104 R; PART B

H. B. LAW, B.Sc.Tech.

An ideal receiver for binary synchronous telegraphy is postulated; this receiver is defined as one that interprets each element of a received signal with the minimum probability of error. The relations between error liability and signal/noise ratio for this receiver are determined for steady signals and for Rayleigh-fading signals in white Gaussian noise, using up to four diversity branches. The noisy-signal performance of a practical receiver can be described in terms of the amount by which it falls short of the ideal, and it is proposed that this measure of imperfection, expressed as an energy ratio, be known as the 'demodulation factor'.

The analysis leads to a mathematical specification for the ideal diversity receiver and this provides a starting-point for the design of practical receivers. The outputs of diversity branches are combined, weighted according to signal energy, instead of the largest output being selected. Very deep fading proves to be of little importance.

Conduction and Induction Pumps for Liquid Metals

PAPER No. 2111 U; PART A

L. R. BLAKE, Ph.D., B.Sc.

Two main types of electromagnetic pump for liquid metals can be distinguished: conduction pumps, a.c. or d.c., in which a magnetic field is established across a tube containing liquid metal, and current is fed to the liquid through electrodes connected to the tube walls; and induction pumps, in which a travelling field induces the required current, as in the induction motor. The induction pump takes three main forms: annular linear (Alip), flat linear (Flip), and spiral (Sip).

These are probably the most useful types of electromagnetic pump for liquid metal, and they are examined and compared in an attempt to predict their relative performances and their main design features.

A Theoretical and Experimental Investigation of Anisotropic-Dielectric-Loaded Linear Electron Accelerators

PAPER No. 2127 M; PART B

R. B. R.-SHERSBY-HARVIE, B.A., L. B. MULLETT, B.Sc., W. WALKINSHAW, M.A., J. S. BELL, B.Sc., and B. G. LOACH, B.Sc.

The general properties of linear-accelerator waveguides loaded with spaced discs of ceramic dielectric are investigated theoretically, and these waveguides are shown to have a higher shunt impedance than all-metal waveguides. Theoretical and experimental methods of waveguide design follow, a combination of which is used to design an experimental linear electron accelerator. Early experience with the accelerator shows considerable excess attenuation, which is probably associated with a high secondary-emission coefficient of the carbonaceous deposits formed; this is later eliminated by using mercury instead of oil diffusion pumps. Provided that suitable precautions, such as the use of a mercury pump, are taken, it is concluded that the way lies open for further development of dielectric-loaded accelerators.

LIBRARY ACCESSIONS

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BOOKS

AMERICAN RADIO RELAY LEAGUE 621.39(03)

The Radio Amateur's Handbook. The standard manual of amateur radio communication

33rd ed. West Hartford, Conn., A.A.R.L., 1956. pp. 766. 24 × 17 cm. 32s. approx.

BARTHO, F. T., and PIKE, C. H. 621.31

Factory Electrification*

London, Macdonald, 1956. pp. x, 398. 22 × 14 cm. 35s.

Deals with the selection, operation and maintenance of distribution equipment and motors for factory machines—including switchgear, transformers, cabling and wiring, considering principles rather than detailed descriptions. The choice of the right type and power of motor for a drive is discussed in detail with emphasis on the economic aspects. This book was reviewed in the June issue.

BRITISH ELECTRICAL DEVELOPMENT ASSOCIATION 621.313

Electric Motors and Controls. Electricity and Productivity Series No. 3*

London, British Electrical Development Association, 1956. pp. xx, 279. 22 × 14 cm. 8s. 6d.

Describes the various types of motor and the choice for a particular job, considering applications in a wide range of industries together with associated gear for automatic control.

BROOKS, W. H. 620.1

Strength and Elasticity of Materials. Vol. IV. Solutions to examination questions of the University of London Part Two (External) B.Sc. (Engineering) 1941–52

London, Macdonald, 1956. pp. 464. 22 × 14 cm. 35s.

COTTON, H. 621.31

Applied Electricity*

4th ed. London, Cleaver-Hume Press, 1955. pp. xii, 496. 22 × 14 cm. 20s.

This edition contains an additional chapter on the analogy between the electric, the magnetic and the dielectric circuits.

DEAN, C. E. (Editor) 621.397.3

Color Television Receiver Practices*

New York, Rider, 1955. pp. vii, 200. 22 × 14 cm. 31s. 6d. approx.

Discusses the fundamental requirements of a colour television system and the specification laid down for a standard signal. Then explains the various stages of a receiver and their functions. A final chapter deals with laboratory apparatus for checking the performance of a colour television receiver.

DRAPER, C. S., and OTHERS 681.2

Instrument Engineering. Vol. III. Applications of the instrument engineering method. Part I. Measurement systems

New York, McGraw-Hill, 1955. pp. xxviii, 879. 29 × 22 cm. £6 11s. 6d.

Describes and illustrates methods for finding solutions to measurement and control problems. Vol. III repeats to some extent the fundamentals and mathematical principles fully developed in the first two volumes. Part 1 covers a wide range of methods and instruments including electromechanical measuring systems, integrators, analogue computers and vibration measuring equipment. Part 2 deals with control system application.

DRUCKER, P. F. 658.15

The Practice of Management

London, Heinemann, 1955. pp. viii, 355. 22 × 15 cm. 25s.

A discussion of the nature and the place of management in business. It is illustrated by accounts of outstanding managerial successes and innovations in such enterprises as Sears, Roebuck and Co., Ford and I.B.M. The discussion of automatic factories is topical and interesting.

DUMMER G. W. A. 621.316.8

Fixed Resistors*

London, Pitman, 1956. pp. xi, 187. 22 × 14 cm. 28s.

The first of a series of volumes covering a range of components. It discusses measurements of fixed resistors, ratings, various common types, high stability and other special resistors (non-linear thermistors, etc.), experimental types, and future developments. There is a bibliography of some 350 references. This book was reviewed in the June issue.

EDDY, J. P. 347.7

Professional Negligence*

London, Stevens, 1955. pp. xii, 146. 21 × 13 cm. 13s. 6d.

Deals in simple terms with the general principles of the law of negligence. Then discusses the position of members of professions, citing the decisions of various cases by way of example.

EMERICK, R. H. 621.311.003

Power Plant Management

New York, McGraw-Hill, 1955. pp. xi, 339. 24 × 16 cm. £2 9s.

This is a book for those in managerial positions who may have to make decisions concerning power plant. It discusses the various types of prime-mover installations available for generating purposes, the problems of fuel storage, smoke prevention, and other operating considerations. Considers capital outlays and running costs (United States) and personnel.

FINK, D. G. (Editor) 621.397.3

Color Television Standards. Selected papers and records of the National Television System Committee*

New York, McGraw-Hill, 1955. pp. xii, 520. 23 × 16 cm. £3 4s.

An edited account of the proceedings of the 2nd National Television System Committee on the recommendations on which the compatible colour television standards of the F.C.C. are based: some of the papers have already been published in the 'Proceedings of the I.R.E.' Covers the colour video and synchronization signal, field tests of compatibility of colour performance and of networks and transmitters, colour films and processes and transmission equipment.

GLASSTONE, S., and OTHERS 621.039

Principles of Nuclear Reactor Engineering*

London, Macmillan, 1956. pp. vii, 861. 23 × 16 cm. £3.

Describes broadly the fundamental principles upon which reactor engineering is based, and the special problems associated with the fission process and radiation. Introductory chapters on reactor theory are followed by chapters dealing with reactor instrumentation and control, processing reactor fuel, reactor materials, radiation protection, shielding, thermal aspects, and description of plant. Although containing problems for the student it is intended to serve also as a reference work and contains a detailed index and bibliographical references.

HALE, A. P. 621.396.82

Electrical Interference*

London, Heywood, 1956. pp. vii, 122. 17 × 13 cm. 15s.

Deals with interference to both radio and television reception. Discusses the causes and the effects, measurement of interference, location of the source, and practical solutions.

HECKSTALL-SMITH, H. W. 537

Intermediate Electrical Theory

Revised ed. London, Dent, 1955. pp. xiv, 679. 19 × 13 cm. 18s. 6d.

Deals with the classical and modern electrical theory. Part I covers the whole of the classical part of the subject without the use of calculus. Part II gives much of the fundamental mathematical theory required for an examination such as Part I of the Natural Sciences Tripos at Cambridge. Part III deals with atomic theory, X-rays, photo-electricity and electronics and contains a note on M.K.S. units.

HICKMAN, R. E. B. 534.85

Magnetic Recording Handbook. Theory, practice and servicing of domestic and professional tape and wire recorders

London, Newnes, 1956. pp. vii, 176. 22 × 14 cm. 21s.

Contains a number of illustrations and diagrams of commercial equipment and a bibliography of references to the literature of the subject.

PEIERLS, R. E. 53

The Laws of Nature*

London, Allen and Unwin, 1955. pp. 284. 22 × 15 cm. 21s.

Sets out the principles of modern physics in simple descriptive language avoiding the use of differential equations and assuming no previous knowledge of the subject.

PRATT, W. T. 621.3(076)

Worked Examples in Electrical Engineering*

3rd ed. London, Hutchinson, 1955. pp. 263. 22 × 14 cm. 25s.

Suitable for students preparing for Higher National Certificate. Revisions have been made where necessary to convert all calculations to the rationalized M.K.S. system.

PRICE, A. B. 621.86

Winding Engine Calculations for the Mining Engineer*

New ed. Erith, Kent, General Electric Co., 1955. pp. 152. 24 × 15 cm. 30s.

A practical work mainly consisting of useful data, diagrams and illustrations.

ROTHE, H., and KLEEN, W. 621.385

Hochvakuum-Elektronenröhren. Band I. Physikalische Grundlagen. (High-vacuum electron tubes. Vol. I. Physical principles)

Frankfurt, Akademische Verlagsgesellschaft m.B.H., 1955. pp. xii, 297. 24 × 17 cm. 27s. approx.

Deals with the theoretical basis of electron tubes considering in detail potential fields (with and without space charge), electron trajectories and electron beams. Vol. II—Characteristics, Vol. III—Applications in input-stage amplifiers, and Vol. IV—Noise effects, are either in preparation or are planned.

RYBNER, J. 518.3

Nomograms of Complex Hyperbolic Functions (In Danish and English)

Copenhagen, Gjellerups Forlag, 1955. pp. 99. 30 × 22 cm.

A feature of these nomograms is the care with which they have been constructed. Included are nomograms for resonance circuits and filters.

SCHULTZ, M. A. 621.039

Control of Nuclear Reactors and Power Plants*

New York, McGraw-Hill, 1955. pp. viii, 313. 24 × 16 cm. £3.

Explains the physics and thermodynamics of the subject as far as possible in engineering terms so that the control problem can be considered as one in servo engineering design. Special reactor components and nuclear instrumentation are described and the control problems during start-up, power operation and shut-down are treated in detail.

SCHURE, A. (Editor) 621.396.619

A-M Detectors

New York, Rider, 1955. pp. v, 58. 21 × 14 cm. 10s. approx.

Describes the variety of circuit arrangements used for a.m. detection and for automatic volume control circuits associated with detectors.

SCHURE, A. 621.396.611.21

Crystal Oscillators*

New York, Rider, 1955. pp. vii, 64. 21 × 14 cm. 9s. approx.

A succinct account of the preparation of crystals for oscillators, their characteristics and the commonly used circuits.

SCHURE, A. 621.396.619

Frequency Modulation*

New York, Rider, 1955. pp. v, 46. 21 × 14 cm. 6s. approx.

Explains the principles of amplitude, frequency and phase modulation and shows how a carrier frequency can be modulated by either of these methods. The advantages of frequency modulation over amplitude modulation are indicated.

SCHURE, A. (Editor) 621.396.615

Limiters and Clippers

New York, Rider, 1955. pp. vii, 56. 21 × 14 cm. 10s. approx.

Describes various circuit devices for amplitude limitation and wave shaping such as are used for radio and television receivers and radar systems.

SEELY, S. 621.38

Electronic Engineering*

New York, McGraw-Hill, 1956. pp. vii, 525. 24 × 16 cm. £3.

This book and 'Radio Electronics', by the same author, are intended as companion volumes, and represent a revision and extension of his book 'Electron-tube Circuits'. It discusses in detail circuits which are not limited to radio but have application in radar, television, control and instrumentation and computers.

SUTTON, J. M. R. 537

Magnetism and Electricity. Vol. I. For students in technical and secondary schools

London, English Universities Press, 1956. pp. xviii, 266. 19 × 13 cm. 8s. 6d.

Provides a basic knowledge of elementary electrical science and shows how the basic principles are applied covering the First Year (SI) course for Ordinary National Certificate and the Ordinary Level of the G.C.E.

TERMAN, F. E. (Editor) 621.396

Electronic and Radio Engineering*

4th ed. New York, McGraw-Hill, 1955. pp. vii, 1078. 24 × 16 cm. £3 11s. 6d.

Although this new edition still contains many problems to be solved by the student its present size makes it very much a reference work. New material has been added to practically every chapter, and the book has been brought up to date. The title, originally 'Radio Engineering', has been altered to indicate the broader coverage of the book. This book was reviewed in the May issue.

THOMSON, J. 621.38

The Services' Textbook of Radio. Vol. 3. Electronics*

London, H.M.S.O., 1955. pp. ix, 259. 25 × 16 cm. 12s. 6d.

Arranged so as to meet the needs of the beginner, the technician and the more advanced reader, whilst a comprehensive index makes it suitable as a work of reference. Deals with valves, cathode-ray tubes and camera tubes, transistors and photocells, and describes their general principles and use as circuit elements. The rationalized M.K.S. system is used throughout this volume; the method of converting from one system to the other will be explained in Vol. 1.

TIMMIS, A. C., and PHILLIPS, W. A. (Editors) 654

Compendium of the Technical Recommendations Issued by C.C.I.F., C.C.I.T., C.C.I.R. of the International Telecommunications Union*

Liverpool, Automatic Telephone and Electric Co., 1955. pp. 416. 17 × 13 cm.

Explains briefly the historical background and present organization of the International Telecommunications Union. Gives the agreements, recommendations and specifications of the telephone (C.C.I.F.), telegraph (C.C.I.T.) and radio (C.C.I.R.) sections, with references to the original documents.

TRINKS, W. 662.9

Industrial Furnaces. Vol. 1*

4th ed. New York, Wiley; London, Chapman and Hall, 1951. pp. x, 526. 23 × 15 cm. £5 2s.

Discusses heat transfer and furnace design principles and the latest operating techniques with sections on the capacity, thermal efficiency, strength and durability, and movement of gases in furnaces.

TRINKS, W. 662.9

Industrial Furnaces. Vol. 2*

3rd ed. New York, Wiley; London, Chapman and Hall, 1955. pp. x, 358. 23 × 15 cm. £4.

Discusses the advantages of gaseous, liquid, and solid fuel and of electrical energy for furnaces. Describes combustion devices and electric heating elements, the control of temperature and of the furnace atmosphere, labour-saving equipment, and safety measures. Gives a critical comparison of the different types of furnace.

UNITED STATES ATOMIC ENERGY COMMISSION 621.039

Research Reactors*

New York, McGraw-Hill, 1955. pp. 442. 27 × 20 cm. £2 9s.

Gives detailed description of six representative types of United States research reactors. Describes their core design and fuel handling, the cooling system, control and instrumentation, shielding, experimental facilities and operating characteristics. Profusely illustrated with photographs and drawings of the plants.

VAN DER ZIEL, A. 621.396.8

Noise*

London, Chapman and Hall, 1955. pp. xi, 450. 22 × 15 cm. £3.

This book is concerned with noise in electronic components and circuits. The various sources of noise are described together with methods of measurement. Statistical methods applicable to noise problems, and Fourier analysis of fluctuating quantities are explained.

WILLIAMS, R. H. 518.5

The Electronic Office*

London, Gee, 1955. pp. 63. 22 × 14 cm. 15s.

Intended as a simple description of the way electronic digital computers work, the binary system, memory storage devices, programming, and possible applications in the field of banking. The list of existing computers in this country and the United States, and some of the other items of factual information may be of interest, although there are no supporting bibliographical references. Some of the explanations may well worry the engineer reading the book.

YOUNG, A. P., and GRIFFITHS, L. 629.11 : 621.3

Automobile Electrical Equipment. A complete survey of electric lighting, starting and ignition as applied to the internal combustion engine*

5th ed. London, Iliffe, 1955. pp. 388. 22 × 14 cm. 25s.

A practical description of automobile electrical systems and equipment containing many circuit diagrams and illustrations.

ZIJL, H. 628.9

Illuminating Engineering Course*

Eindhoven, Philips Technical Library, 1955. pp. viii, 243. 21 × 15 cm. 23s. 6d.

Deals with the physics of light, measurements used in illuminating engineering, vision, and the quantity of illumination for practical rather than artistic purposes. Then discusses various forms of lamps and lighting systems.

OTHER PUBLICATIONS

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ABC Conference on Unification of Engineering Standards. Canada, United Kingdom, United States

New York, A.S.M.E., 1955. pp. 87. 22 × 14 cm. 12s. approx.

ATOMIC ENERGY COMMISSION GROUP. DEPARTMENT OF SECURITY COUNCIL AFFAIRS

An International Bibliography on Atomic Energy. Vol. 1. With supplements 1 and 2. Vol. 2. With supplement 2.

New York, United Nations, 1949–1953. 28 × 22 cm. £5 6s. 3d.

CENTRAL OFFICE OF INFORMATION

The Commonwealth and Nuclear Development

London, H.M.S.O., 1955. pp. 52 23 × 15 cm. 2s.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

A Brief Review of Science and Technology in Western Germany

London, H.M.S.O., 1955. pp. viii, 103. 24 × 15 cm. 4s.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Report for the Year 1954–55

London, H.M.S.O., 1956. pp. 321 24 × 15 cm. 7s. 6d.

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Working Metals by Electro-Sparking. An abridged translation from the Russian

London, H.M.S.O., 1956. pp. iii, 66. 24 × 15 cm. 5s.

DE WITT, N.

Soviet Professional Manpower. Its education, training, and supply

Washington, National Science Foundation, 1955. pp. xxviii, 400. 23 × 15 cm. 11s. approx.

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MIDDLE EAST

J. M. MORRIS, O.B.E., The Port Directorate, Basrah, Iraq.

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NEAR EAST

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Deputy Representative: PROFESSOR R. W. SLOANE, M.A., PH.D., B.SC., Director of Engineering, Experimental and Service Laboratories, American University of Beirut, Division of Engineering, Beirut, Lebanon.

NEW SOUTH WALES

V. J. F. BRAIN, B.E., Chairman, The Electricity Authority of New South Wales, Treasury Building, Bridge Street, Sydney.

NEW ZEALAND

E. H. R. GREEN, C.B.E., M.SC., Engineer-in-Chief, General Post Office, Wellington C.1.

PAKISTAN

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QUEENSLAND

J. S. JUST, c/o Box 1067N, G.P.O., Brisbane.

RHODESIA

A. B. COWEN, O.B.E., P.O. Box 377, Salisbury.

SOUTH AUSTRALIA

G. H. MACHIN, B.E., c/o The Electricity Trust of South Australia, Box 412C, G.P.O., Adelaide.

SWITZERLAND

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TRANSVAAL

A. W. LINEKER, B.SC., P.O. Box 7794, Johannesburg.

UNITED STATES OF AMERICA

Hon. Secretary: R. H. BARCLAY, The J. G. White Engineering Corporation, 80 Broad Street, New York 4, N.Y., U.S.A.

VICTORIA AND TASMANIA

PROFESSOR C. E. MOORHOUSE, M.E.E., Department of Electrical Engineering, University of Melbourne, Carlton, N.3, Victoria.

WEST AFRICA

J. HOUSTON ANGUS, Electricity Corporation of Nigeria, Ijaros, Lagos, Nigeria.

WEST INDIES

H. D. WALDEN, B.SC., c/o Trinidad Leaseholds, Ltd., 19 La Carriere Road, Point-a-Pierre, Trinidad.

WESTERN AUSTRALIA

J. B. JUKES, B.E., The State Electricity Commission of Western Australia, Electricity House, 321 Murray Street, Perth.

Joint Oversea Groups

ARGENTINA
Chairman: R. M. DRYSDALE, A.M.I.MECH.E.
Hon. Secretary and Treasurer: J. COOMBES, A.M.I.C.E., c/o Percy Grant & Co., Reconquista 314, Buenos Aires, Argentina.

HONG KONG
Chairman: S. E. FABER.
Hon. Secretary and Treasurer: J. J. ROBSON, A.M.I.C.E., c/o Port Works Office, Public Works Dept., Hong Kong.

IRAQ AND PERSIAN GULF
Chairman: N. D. FETTO, B.SC.(ENG.), M.I.C.E.
Hon. Secretary: J. A. C. KING, A.M.I.E.E., c/o Department of Electricity, Government of Kuwait, Kuwait, Persian Gulf.

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Hon. Secretary: C. G. V. RUDD, M.SC., A.M.I.MECH.E., A.M.I.E.E., Alliance Engineering Co. Ltd., 6/7 Telegraph Street, Singapore.

WEST AFRICA
Chairman: J. HOUSTON ANGUS, M.I.MECH.E., M.I.E.E.
Hon. Secretary: R. E. J. WHITE, A.M.I.MECH.E., A.F.R.AE.S., c/o U.A.C. (Tech.) Ltd., P.O. Box 570, Lagos, Nigeria.

Graduate and Student Section Officers

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Hon. Secretary: T. E. B. CASELEY, S.W. Electricity Board, Romney Avenue, Lockleaze, Bristol.

CARDIFF
Chairman: J. H. DENMAN.
Hon. Secretary: D. J. WILLIS, 4 Cwm Fedw, Machen, Newport, Mon.

EAST MIDLAND
Chairman: R. M. JELFS.
Hon. Secretary: B. WILSON, B.SC., 223 Charlbury Road, Wollaton, Nottingham.

LONDON
Chairman: K. W. E. GRAVETT, M.SC.(ENG.).
Hon. Secretary: J. J. PEACOCK, 98 Lady Lane, Chelmsford, Essex.

MERSEY AND NORTH WALES
Chairman: S. G. GRIFFITHS.
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Hon. Secretary and Treasurer: J. N. H. WARD, B.SC., 72 Osborne Road, Jesmond, Newcastle upon Tyne.

NORTH MIDLAND
Chairman: D. PITTS.
Hon. Secretary: D. HARDY, B.SC., 46 Mountjoy Road, Huddersfield.

NORTH SCOTLAND
Chairman: J. B. ABBOTT.
Hon. Secretary: A. J. S. DAVIDSON, B.SC., c/o Electrical Engineering Dept., Queen's College, Dundee.

NORTH STAFFORDSHIRE
Chairman: A. P. BAINES.
Hon. Secretary: A. DAVIES, B.SC., Switchgear Engineering Dept., The English Electric Co. Ltd., Stafford.

NORTH-WESTERN
Chairman: H. HAMMERSLEY.
Hon. Secretary: J. C. HOPKINS, B.SC., Research Dept., Metropolitan-Vickers Electrical Co. Ltd., Trafford Park, Manchester, 17.

NORTHERN IRELAND
Chairman: W. M. BARRON.
Hon. Secretary: T. C. JACKSON, 99 Deerpark Road, Belfast.

RUGBY
Chairman: A. R. PETHERAM, B.SC.(ENG.).
Hon. Secretary: A. J. GILBERT, Plant Engineering Department, British Thomson-Houston Co. Ltd., Rugby.

SHEFFIELD
Chairman: J. R. BENNETT.
Hon. Secretary: H. C. MORTIMER, 5 Guest Road, Sheffield, 11.

SOUTH-EAST SCOTLAND
Chairman: J. BEWS.
Hon. Secretary and Treasurer: J. PRINGLE, 3 Council Houses, Fountain Hall, Stow, Midlothian.

SOUTH MIDLAND
Chairman: A. H. BOYSON.
Hon. Secretary: J. B. ATKINSON, B.SC.(ENG.), 1 William Bree Road, Allesley, Coventry.

SOUTH-WEST SCOTLAND
Chairman: A. AKED, B.SC.
Hon. Secretary: J. C. EASTON, 29 Castle-Chimmins Road, Cambuslang, Glasgow.

SOUTHERN
Chairman: J. WILLIAMSON.
Hon. Secretary: R. J. BARNARD, B.SC., 34, Brockenhurst Avenue, Leigh Park, Havant, Hants.

Elections and Transfers

The following elections and transfers were approved by the Council during May and June, 1956.

ELECTIONS

Associate Members

BAILEY, John Ferriman.
BARACZ, Andrew John.
BARNETT, James Michael Nutcombe.
BIGGAR, Henry Peter Howland, B.SC.(ENG.).
BIRCH, Andrew Geater Logie Ritchie.
BREWSTER, Arthur Edward.
CLARK, Harold William.
CLARKE, Richard Gregory South.
CLEAR, Michael Charles, B.SC.(ENG.).
COLLIS, George Albert.
CROFT, Edwin.
DUCKWORTH, John Clifford, B.A.
DUDDINGTON, Cyril.
GROSBARD, Leonard Anatole.
HARRISON, Graham Alfred, M.A.
HARROP, John Wilton, B.SC.
HERBERT, Robert Allen, M.A.
JANNAWAY, Bernard Edward.
JONES, William Frederick.
KELLER, Patrick Robert, B.SC.
KNIGHT, George Arthur.
LARCHET, Gerard John, B.E.
LAWSON, Clement Stephenson.
LEE, Frank James.
LOVELL, Frank Ward.
MACBETH, Millen, M.SC., B.E.
McEVOY, Eugene.
MARSH, Robert Victor Richardson.
PALMER, Alan, B.SC.TECH.
POLLARD, Cmdr. Arthur Alan Whitshed, D.S.C., R.N.(RETD.).
POTTS, Thomas William.
RAISBECK, Clarence Norman, B.SC.
SANDMEIER, Henry Armin, DR.SC. TECHN., E.E.
SERWAREY, Jiwan Singh.
SIRAJUDDIN, Aslam Walter.
SMITH, Wilfred.
STOREY, Lt. Richard Walter, B.A., R.N.
SUTTON, Roy Norman.
TUCK, Leonard Frank.
TYLER, Horace Lionel.
WATTS, Gilbert Bourne, B.SC.
WELLS, Capt. Roderick Graham, B.SC.
WILSON, Philip Lonsdale.
WINTRIP, John.
WOOD, Alan Roy.

Associates

BROOKS, William Harold.
COMPTON, Henry Kenneth.
DOUGLAS, Thomas Pittendrigh.
FOWLER, Charles Harold.
GIBBS, Stanley Robert.
GOODSMAN, Ronald Felix.
GREEN, Major Harold Kelson, R.E.
GREENWOOD, Arthur.
HALLIDAY, Bryce Stevenson.
HONEY, William John.
MUSTOE, Douglas Howard.
O'KEEFFE, Lt.-Cmdr. John Michael, R.N.
PARR-MORLEY, John, M.M.
SMITH, Leslie Edwin.
STEPHENSON, Oswald Allen.
WALKER, Lt.-Cmdr. Alfred Sydney, R.N.
WHITWELL, Arthur Leslie.
ZEFFERT, Harry.

Graduates

ALLAN, William Harold.
BAYES, John Cecil.
BENYON, John Maxwell, B.E.
BUCK, Gordon Alan.
CLARKSON, Peter Norman.
DREW, Ivor Charles.
DUNN, Douglas John.
DYSON, Clifford.
EARLE, Harry Oake.
EPLER, Jerzy, B.SC.(ENG.).
FISH, Percy John, B.A.
HARDING, Jack.
HOPKINS, Fl.-Officer Charles Cedric, R.A.F.
JOHNSON, Major Kendrick Peter, R.E.M.E.
JONES, Dennis.
JUNQUERAS, Armando Guillermo.
LITTLE, Michael John, B.SC.(ENG.).
MERICAN, Idaham Othman.
MOODY, Antony John.
MOORE, Joseph Edward.
MORGAN, Alexander Edward Murray.
MORGAN, John Fabian.
MOULTON, George Dudley.
MUSSARED, Peter Llewellyn, B.E.
NEALE, Kenneth Paton, B.SC.(ENG.).
PADWELL, Cecil Arnold.
PUTT, James Timothy.
RAAD, John Arthur.
READER, Clifford Ernest, B.SC.(ENG.).
REYNOLDS, Norman George.
ROBERTS, Murtland Cedric.
ROSSINGTON, Robert Frank.

Graduates—(contd.)

SAGNARD, François Régis.
SIMONS, Harold Leon.
STOKES, Benjamin Albert.
SYKES, Norman George, B.SC.(ENG.).
WAIK, Frank Louis.
WALKER, Ronald, B.SC.
WALLACE, Oswald.
WILLIAMS, George.
WOJTAS, Boguslaw.
YATES, Frederick Malcolm.
YOUNG, Hugh.
ZIELINSKI, Lech Stefan.

Students

BADMAN, Ronald George.
BAKER, Gordon Dalby.
BAXTER, Robert Ogilvie.
BECKFORD, Donald.
BELLAMY, Norman West.
BONNER, Peter Brian, B.SC.
BRADLEY, Geoffrey Alan.
BROWNE, Peter Edward.
BUCKHAM, Malcolm William.
BYRNE, Daniel.
COKER, John.
COOPER, Alan Cadmore.
CORNISH, Alan Richard Henry.
CURRY, David Alan John.
DORTON, David Henry.
FINNAMORE, John Harold.
GUTTRIDGE, Josiah.
HACKING, Dennis Ernest.
HARRIS, Derek Edward.
HENG, Chiu Poh, B.SC.
HODGSON, David.
KEATINGE, Peter Anthony Terence.
KENDALL, Peter Maurice Holland.
KESTAS, Philip Christopher.
LAVIN, James Vincent.
LENG, John.
McLOUGHLIN, Peter.
MOLE, David Henry.
NARKE, Dattatraya Vishwanath, B.E.
NAOKES, John William.
O'NEILL, Hugh Joseph.
PARNELL, James Crawford.
PERIES, Thammahettimudalige Don George Frederick Anselm.
ROWSELL, Clive Anthony.
SALEH, Mustafa A. W., B.SC.
SHARMAN, Ernest Keith.
SHORT, Derek.
SMITH, Colin Morice.
TOPLIS, James Richard.
TYLER, Michael John.
TYLER, Terence John.

TRANSFERS

Associate Member to Member

BARWICK, Emerson Clarke, B.SC.(ENG.).
BRUTY, Alfred Owen.
BUCKINGHAM, Alfred, B.E.
CONNERTON, Wing-Cdr. Charles Daniel, R.A.F.
COOPER, Cecil Redvers, B.SC.(ENG.).
CUTHBERT, Geoffrey Townley, B.E.
ECKERSLEY, Tom.
EDWARDS, Charles Philip, M.SC.TECH.
ESMOND, Leslie Purcell.
HANSFORD, Richard Norman, M.A.
HOOKER, John Keith, B.E.
JAMES, Griffith Alcwyn.
LE PAGE, William Charles.
McCARTNEY, Hugh.
MILNE, Kenneth Harvey, B.E.
OUTRAM, William John, M.ENG.
PATERSON, David.
PENDLETON, Leslie.
PERRIGO, Albert Edward Bell, M.SC., B.SC.(ENG.).
PHILIPP, Walter, B.SC.
POLLARD, Archibald Hayward, B.SC.(ENG.).
PRENTICE, Sydney Arthur, M.E.E., B.SC.
ROWBOTTOM, Richard Albert.
SMITH, Ernest Leslie.
SMITH, Maurice Joy, O.B.E., B.SC.(ENG.).
SPOONER-LILLINGSTON, Edward Lancelot, B.A.
TELFORD, Robert, B.A.
THORNTON, David Martin, B.SC.
TRAFFORD, William, M.B.E.
TURNER, Henry Thomas.
WORK, Col. Andrew Leslie, B.SC., R.E.M.E.
WORMALL, John Bryan.
YOUNG, Robert Eric, B.SC.(ENG.).

Associate to Associate Member

DICKINSON, John Clegg.
MEDCALFE-MOORE, John.
POOLE, William Nolan, B.SC.
SAGOO, Harbhajan Singh.

Graduate to Associate Member

ALVES, Thomas Hartley, M.A., B.SC.(ENG.).
ASPDEN, Harold, PH.D., B.SC.
BANKS, John Hartley, M.SC.
BEAGLEY, Eric John Vivian.
BEDDOE, Stanley.
BELIN, Rudolf Ernst, M.SC.
BENDALL, John Gordon.
BENNETT, Adrian Michael, B.SC.(ENG.).
BERGER, Bruno, B.SC.(ENG.).
BLACK, Jan, B.SC.(ENG.).
BLACKIE, Ian Turnbull Broom.
BLADON, John Adrian, B.SC.
BLAIR, Andrew Gibson.
BOARD, John Edwin, B.SC.(ENG.).
BOND, Gwynfryn George, B.SC., PH.D.
BRIDGE, Clifford Thomas, B.SC.
BRODRIBB, Peter Bower, B.A.SC.
BROOKE, Aubrey, B.SC.(ENG.).
BRYCE, William Gerard, B.SC.
CALDER, David Everard, B.E.
CAMERON, William Alfred.
CHANDLER, Thomas Wilfred.
CLARK, Graham Makepeace.
CLAYTON, Robert James, M.A.
COCKERILL, Francis Geoffrey.
COWELL, Charles Edward.
COWIE, Peter Lindsay, B.E.
CRISP, Anthony Joseph Ernest.
DAVENPORT, Frank William Thomas.
DAVIES, David Roy.
DITTMER, Harry.
DIXON, Alan.
DIXON, Fred.
DOREY, Peter Francis, B.SC.(ENG.).
EAGLE, Derek William.
ELLSON, Allan Henry, B.SC.(ENG.).
EVANS, Frederic John, B.ENG., B.SC.
FASEY, Norman William.
FERRANTI, Barry Zani de, B.SC., B.E.
FLINT, Ernest Frederick.
FORSTER, Fred.
FREE, Leslie Robert, B.SC., B.E.
GILES, Antony Ernest, B.SC.(ENG.).
GIMSON, Keith Frederick, B.SC.(ENG.).
GODFREY, Nelson Frederick John.
GOODBURN, Raymond Charles, B.SC.(ENG.).
GORMAN, Anthony Graham.
GUDGEON, Robert Lightfoot, B.SC.(ENG.).
HAIRE, Thomas Peter.

Graduate to Associate Member—(contd.)

HAWORTH, Robert Brian, B.SC.
HAYMAN, Edward George, B.E.
HEATHCOCK, George Ernest Gordon.
HENSHAW, Eric, B.SC.(ENG.).
HIGGS, Graham Ward.
HUMPHRIES, John Davison, B.SC.(ENG.).
HUNTER, Leslie Oscar.
HURST, Alan, B.SC.(ENG.).
JACKSON, Kenneth Frank, B.SC.TECH.
JANES, Maurice Vincent.
JOSEPHIDES, Theodore Stavros, B.SC.TECH.
KELSALL, James Edward.
KIGHTLEY, Peter Raymond.
KORYTKO, Tomasz Kazimierz Maria, B.SC.(ENG.).
LANE, Peter Stanley, B.SC.(ENG.).
LANGFIELD, Geoffrey Fernley, B.SC.(ENG.).
LATHAM, Peter, B.SC.
LAWRENCE, Derek Howard.
LEES, Henry John Patrick, B.SC.
LENIHAN, John Mark Anthony, M.SC., PH.D.
LEWIS, Glynne.
LINDSAY, Trevor Rowan Leonard, B.SC.
LITTLEHALES, Gerald Claude, B.SC.(ENG.).
LLOYD, Norman Kenneth.
McCOMBIE, Rowland Walter.
McGARRY, Douglas Wilfrid.
McMULLAN, Dennis, M.A., PH.D.
McNAUGHT, Adam Robertson.
MARDERWALD, Leslie Marian, B.SC.(ENG.).
MARSDEN, Donald John, B.SC.(ENG.).
METCHER, Brian Carey, B.SC.(ENG.).
MILLAR, Joseph Brian, B.SC.
MILLER, John Tate.
MILNE, William Hardy.
MORRISON, John Mackenzie, B.SC.
MUCHMORE, Norman William Wilfrid.
MURRAY, Alexander Thomas Lambert.
NEWTOWN, Stanley.
NIXON, Joseph Kenneth.
OATEN, George Stanley.
OATEY, Leonard William.
OCHERT, Nathan, B.SC.
OLIVER, Walter Leonard.
OSWALD, Robert Nutman.
OVENS, Ralph Clifford, B.SC.
PADDOCK, Frederick John.
PATEL, Dahyabhai Motibhai, M.E.E.
PEGG, Brian Albert George.
PERCIVAL, Sydney David Beresford.
PETTET, Norman Francis.
PHILLIPS, Donald, B.SC.
PIZER, Henry Ian, B.E.E.
POOLE, Richard Herbert.
PRYOR, James Lindon, B.SC.(ENG.).
RANDS, Geoffrey Frederick, B.E.
REED, Capt. William Charles, R.E.M.E.
RHODES, John Wright.
RILEY, Thomas Brian, B.SC.TECH.
ROBINS, Robert Hill.
ROBINSON, William, B.SC.
RUDD, Alan Hugh.
RUDZINSKI, Zbigniew Stefan, B.SC.(ENG.).
SALT, Alfred George.
SAMUEL, George Henry, B.SC.
SANIGAR, Flt.-Lt. William Adrian George, R.A.F.
SCOTT, Ian George, B.SC.
SEADEN, Ernest Robert, B.SC.(ENG.).
SHAH, Navnilal Popatlal, B.E.
SHARP, James.
SIMMONS, Brian Desmond.
SKINNER, Roy Harry, B.SC.(ENG.).
SMALL, George Frederick, B.SC.(ENG.).
SMITH, Thomas Charles.
SPEARING, Michael Henry.
SPOONER, Arthur Edwin.
STEELE, Kenneth George.
STEELE, William Edward, B.SC.(ENG.).
STEPHENSON, Denis, B.SC.
STOCK, Philip Bertie.
SUTTON, George Gurney, M.SC.
TEAGUE, Godfrey William.
TEDESCO, Thomas Victor, B.ENG.
THOMAS, David Salsbury, B.SC.
THOMAS, Philip Neam, B.SC.
THOMPSON, John William (*Chelmsford*).
THOMPSON, John William (*Khartoum*).
THORPE, Alfred.
TOFT, Eric Nixon, B.SC.
TURNER, Clifford Henry.
UMPLEBY, Frederick Roger, B.SC.(ENG.).
VOCE, Thomas Charles.
WAINSCOT, Arthur John, B.SC.(ENG.).
WALKER, Major Derek William Rothwell, R.E.M.E.
WESTBROOK, Hugh Wyeth.
WESTON, Roy Hornby.
WHATSON, John Dudley, B.SC.(ENG.).
WHETTON, Harry.
WHITE, James Thomas.
WHITEHEAD, Leslie Ronald, B.SC.(ENG.).
WIERZBOWSKI, Stanislaw Witold.
WILLEMSTYN, Emil Bernard, B.SC.(ENG.).
WILLIAMS, Thomas Edward, B.SC.
WOLFENDALE, Eric, B.SC.(ENG.).
WOODHEAD, Gordon Edgar.
YOUNG, Archibald Henderson.
YOUNG, George Alfred Ernest.

Student to Associate Member

COOPER, Dennis Cyril, B.SC.
DODD, Major Edward Charles, R.E.M.E.
MIDWOOD, John.

Student to Graduate

BALL, Sub-Lt. David Richard, B.SC.(ENG.), R.N.V.R.
BROMIDGE, John Treverton, B.SC.(ENG.).
CARROLL, Lancelot Reginald.
COCKBURN, James.
CROSS, Geoffrey Arthur.
DEBOO, Gordon John, B.SC.(ENG.).
DUERDEN, Peter, B.SC.
EL HAKIM, Yahia, B.SC., PH.D.
GILLESPIE, Ernest Fred Francis, B.ENG.
GLASBY, Peter Anthony, B.SC.(ENG.).
GOLDBERG, Manfred, B.SC.(ENG.).
GOTTFELDT, Peter, B.SC.(ENG.).
HARDY, Ronald John.
HOLLELY, Roger William, B.SC.
HUDDART, Anthony John, B.SC.TECH.
KROL, Jerzy Romuald.
LAMBERT, William John.
LUDBROOK, Allan, B.SC.TECH.
MAGOWAN, James Alexander.
MALLALIEU, Brian David.
MEDWAY, Norman Aubrey.
MORLEY, David Argyll.
MURASZKO, Jan Tadeusz, B.SC.(ENG.).
NELSON, Fred.
OLVER, David Bryan.
OLVER, Michael Blanchard.
RIMMER, David Harry, B.SC.
SATHIRAKUL, Kamhaeng, B.SC.(ENG.).
STEVENSON, Reginald Sidney, B.SC.
SWE, Tin, B.SC.(ENG.)., M.S.E.E.
TURNER, Brian James, B.SC.
WHITESIDE, Roy Sydney, B.SC.(ENG.).
WINTERS, Rex Henry.

HOME EVENTS

LONDON

ORDINARY MEETING

Nuclear Reactors and their Control

The Ordinary Meeting held on the 5th April, 1956, under the chairmanship of the President, Sir George Nelson, was a special event. It was the first meeting organized by The Institution in conjunction with the British Nuclear Energy Conference, and there was a large attendance from countries oversea, including a delegation from the Soviet Union and representatives from Holland, Norway, Sweden, Belgium, France and Germany. Four papers were presented at the meeting on nuclear reactors and their control, all the authors being members of the United Kingdom Atomic Energy Authority.

The first paper presented was by Mr. A. B. Gillespie, and was in the form of an introductory lecture to the whole subject. It dealt with the control and instrumentation of a nuclear reactor, and presented a survey of the complete instrumentation of a typical research reactor.

The second paper by Mr. A. J. Cox and Mr. J. Walker dealt with the physics of nuclear reactors in so far as these principles affect the control of reactor plant. A great deal of information was included in this paper on the kinetic behaviour and reactivity changes in various types of reactor, and the control and instrumentation techniques practised at the Atomic Energy Research Establishment were outlined.

The third paper, by Mr. W. Abson and Mr. F. Wade, dealt with the more specialized subject of reactor-control ionization chambers, and included details of the design and performance of a neutron-sensitive d.c. ionization chamber suitable for a wide range of applications in control circuits. The fourth paper, on another specialist subject, was by Mr. G. E. Lockett, and was concerned with the detailed engineering design of reactor-control mechanisms.

The discussion which followed was valuable not only for the critical and useful comment on the material presented in the four papers, but also because several speakers, particularly those representing the other European atomic energy establishments, were able to describe alternative designs and parallel experience. The following spoke in the discussion: Dr. Denis Taylor, Mr. R. V. Moore, Mr. P. Lion (Oslo), Dr. van Zollingen (Arnhem), M. Weill (Saclay), Dr. Schultz (Germany), Mr. K. R. Sandiford, Mr. J. H. Bowen, Dr. J. H. Mitchell, Mr. R. J. Smith, Mr. H. H. Heath, Mr. R. Parr, Mr. Shonehoure and Dr. J. B. Birks.

Some of the special points which were discussed were the justification for siting ionization-chambers near, rather than in, the reactor core, and the relationship between the measured ionization current and the operating power level under these conditions; the analysis of reactivity control rates for different reactor types to determine the best conditions for a safe but reasonably fast starting up, and the need for a complete investigation of this problem using analogue methods; the possible use of radiation detectors other than the ionization chamber for the measurement of power level, in particular the use of scintillation counters in certain, apparently rather limited, circumstances; the importance of physical instrumentation, especially in large production and power reactors, and the novel problems that this involves; the design of control mechanisms for high-pressure systems using water coolants; the advantages of the suspension reactor, which, owing to the fuel being in the form of small particles, may permit the continuous extraction of fission products, thus simplifying some of the control problems; the use of automatic start-up and operation, and the degree of complexity permissible and reasonable for the safety circuits; and the difficulties experienced with d.c. amplifiers and the possibility of using a.c. techniques throughout. Altogether the discussion was most profitable. Many questions were asked and many forceful comments were made, and the authors responded with equally forceful and informative answers.

The control room of Zeus—the newest Harwell reactor

The meeting closed with a few words from the President thanking the authors and the discussion speakers for their contributions to the meeting. D. T.

SUPPLY SECTION

MEASUREMENT AND CONTROL SECTION

Measure for Measure

Papers on insulating materials, especially where they are related to cables, invariably provoke a high level of interest, and the three papers presented at the joint meeting of the Measurement and Control and the Supply Sections on the 25th April proved no exception. These papers were entitled *Physical Properties and Impulse Strength of Paper*, by H. C. Hall and E. Kelk; *The Impulse Strength of Lapped Impregnated Paper Dielectric*, by H. C. Hall and D. J. Skipper; and *Breakdown under Impulse Voltages of Solid and Liquid Dielectrics in Combination*, by W. G. Standring and R. C. Hughes. The Chairman of the Supply Section presided at the meeting.

Speaking before a well-filled theatre, the authors succinctly outlined their contributions and thereby provided a fruitful field of discussion. When one knows Mr. R. Davis will be opening a discussion, it can be expected that the breeziness associated with his native coast will prevail, and members

were not disappointed. He agreed that the apparently simple electrostatic problem of cables involves factors which necessitate detailed study and then only permit generalizations. He indicated a preference for data to be presented in full, leaving those interested to deduce interpretations which might provide other views. He considered that statistical methods had been employed to an extent which occasioned disquiet—a Parthian shaft which highly amused the audience and intrigued them as to its effect.

Mr. L. C. Richards, declaring his interest in the combinations of solid and liquid dielectrics, thought that the full study would be a lengthy process and emphasized the need for continuity. He stressed the importance of assessing the breakdown strength at the higher temperatures and desired the elaboration of the observations on the pre-breakdown conditions.

Mr. C. C. Barnes thought that the measurements described were valuable, and, in examining the results, he raised points about the paper, the effect of bending and carbon-paper screening, and he concluded by hoping that the newer synthetics might prove attractive. Dr. B. Salvage, in a masterly exposition, gave his views on the effects of density and impermeability of the paper. His work showed that the impulse strength decreases with paper density, but the effect of impermeability must also be related to the viscosity of the impregnant.

Mr. H. F. Church, on studying the kindred problems of papers for capacitors, had deduced that the wide range found in the expected life can be associated with minimum thickness variations, and by relating these to stressing found a distribution curve similar to those from impulse testing. The advantages of the cable-model testing technique were endorsed by Mr. D. H. Booth, but he expressed surprise at the authors' view that the stranding and conductor sizes have less effect than that usually attributed to these factors. In concurring with the findings on impermeability, he felt that the impulse strength of the paper might be adversely affected in attempting to achieve high permeability.

Members were glad to welcome Mr. G. Palandri from Italy, whose researches in collaboration with his colleague, Mr. P. Gazzana-Priaroggia, in the field of cable dielectrics have already established a high reputation. He stated that the independent confirmation now provided on the vexed question of relationship between impulse strength and the viscosity/temperature characteristic of the impregnant was appreciated. Commenting on the polarity-reversal effect observed, he said that in his experience the reduction of apparent impulse strength was less than that indicated by Hall and Skipper, and he had shown that stranding caused a lowering of impulse strength. Referring to the paper by Hall and Kelk, he considered that the plying of paper affected the impulse strength observed.

With Mr. A. E. Brierley, the discussion moved to the paper by Standring and Hughes and its relation to transformer testing, with particular reference to the effect of repeated applications of impulses and polarity effects. He felt that the mechanism of breakdown could conceivably change character depending upon the relative positions and proportions in the combinations.

Mr. F. C. Walmsley supported the suggestion that the work on the combinations of solid and liquid dielectrics should be continued and extended. On examining the section dealing with combined tangential and normal stress, he found that the authors had disproved earlier assumptions and commented that the character of the breakdown paths found might be related to the permittivity of the various media examined. Stressing the limitation of cable-model tests, Dr. F. Miranda also commented on the possibility of dielectric fatigue being associated with electrode configuration or the presence of gas, and he emphasized the importance of adequate impregnation.

An excellent contribution by Mr. P. R. Howard described the work at the National Physical Laboratory. He expressed the view that the effect of the number of butt gaps would, within limits, appear to outweigh paper qualities, and confirmed that the stranding effect did not appear significant; yet other work on life-size pressure cables pointed to the contrary, and this could not be overlooked. The initiation point of the breakdown path then received attention, and he inferred that the complexity of the breakdown process was not necessarily related solely to the electric strength of the oil, but also to the involved capacitance network present.

Dr. H. House suggested that with combinations of solid and liquid dielectrics an arrangement producing breakdown through the specimen should be used instead of a conventional cylindrical electrode system. From general observations, Mr. G. W. Bowdler proceeded to a suggestion that the increased strength of the oil-impregnated material is created by the obstruction to ionic or solid-particle movement which the fibrous structure provides. Dr. J. H. Mason raised the point that the electric strength of pressboard appeared to be independent of electrode configuration, and he advocated the use of discharge detectors for the predetermination of discharge inception levels.

At this point the Chairman terminated the discussion, which had been both full and lengthy. Unfortunately time precluded its continuance although additional contributors were ready to join issue with the authors, who welcome their views as written contributions to the discussion.

Mr. Hall, in expressing his appreciation of the comments made, showed that with his colleagues he was fully satisfied with the statistical methods employed, thus blunting Mr. Davis's shaft. He made special mention of some of the highlights of the discussion and indicated that agreement existed between results on cable models and full-size cable samples. Mr. Standring emphasized that in presenting his paper with Mr. Hughes, they had perforce to restrict the parameters of their investigation and then to make a number of generalizations.

Mr. W. Bamford, Chairman of the Measurement and Control Section, expressed his appreciation of the measurement and control which Mr. L. Drucquer had exercised in handling the discussion, and concluded with the reflection that the work of the engineer is concerned with the inconsistencies in paper, and his daily life is affected by those printed on it.

F. C. W.

SUPPLY SECTION

More Power from Niagara

The Supply Section annual lecture was given by Dr. R. L. Hearn, at the meeting held on the 16th May under the chairmanship of Mr. L. Drucquer. Dr. Hearn chose as his subject the most recent development in the utilization of power from the Niagara Falls, the Sir Adam Beck Generating Station No. 2. The subject and its presentation in London were of particular interest as it was in London, at Brown's Hotel, that the original commission for the method of developing power from the falls met in 1890, under the

chairmanship of Lord Kelvin. Their recommendation was electric generation using alternating current. Dr. Hearn's lecture described the final stage in the development of this recommendation.

Comprehensive studies, using models, showed that it was possible to divert more water from the falls without reducing their scenic value and at the same time to reduce the rate of erosion, which was about four feet per year. These studies resulted in the Diversion Treaty of 1950 between Canada and the United States. This treaty ensures the retention of the scenic value by defining the minimum amount of water which must flow over the falls but permits a lesser flow at night. Any water in excess of this minimum can be diverted for power purposes. The increase in the water which can be diverted nightly makes storage attractive, and as a suitable site was available, pumped storage is incorporated in the scheme.

The water extracted from above the falls is about 50 000 ft^3 (315 000 gal) per second. This is carried through twin tunnels of 45 ft diameter for about five miles, and then through an open-cut canal for a further two miles to twelve generators each rated at 80 500 kVA.

Dr. Hearn used coloured slides to illustrate the various stages of construction and after the lecture showed a coloured film. Of particular interest were the water-flow patterns illustrating the solutions to two major hydraulic problems. The first was the intake, above the falls, where considerable ice accumulation can occur. The solution was submerged entries, each 500 ft long, parallel to the river flow so as not to introduce any obstruction. The second was where the waters from the original open channel, feeding the Sir Adam Beck Generating Station No. 1, mix with the new open-cut canal for No. 2.

Dr. L. G. Brazier, in proposing the vote of thanks, gave a brief history of Dr. Hearn's life. He was born in Toronto within a few days of the meeting at Brown's Hotel of Lord Kelvin and his colleagues, and was educated in Toronto, graduating in 1913. His first job was with the Hydro-Electric Power Commission of Ontario, of which he is now Chairman. In 1921 he left them and spent some three years in the United States, returning to Canada as Chief Engineer to H. G. Acres and Co., Consulting Engineers. In 1942 he returned to the Hydro-Electric Commission. Many societies have been pleased to confer honours on Dr. Hearn. To mention a few—in 1952 he was awarded the Honorary Degree of Doctor of Engineering from the University of Toronto and was also appointed a Director of Atomic Energy of Canada, Ltd., in 1954 he was awarded the Julian C. Smith medal by the Engineering Institute of Canada for 'achievement in the development of Canada', in 1956 he was awarded the Medal for Outstanding Achievement by the Association of Professional Engineers for 'his distinguished accomplishments in the sphere of hydro-electric engineering and for his contribution to the welfare of mankind in furthering the application of nuclear fission in peace-time uses'.

The vote of thanks was seconded by Dr. Mortlock, who confined his remarks to Dr. Hearn's activities other than engineering. He is a Director of the Ontario Safety League, a Fellow of the Canadian Geographical Society, a member of the Advisory Board of the Boy Scouts Association of Metropolitan Toronto, a member of the Federation of Ontario Naturalists, and last, but not least, a keen photographer—in all, a refutation of the usual criticism of the lack of cultural interests of an engineer.

The Chairman on behalf of The Institution thanked Dr. Hearn for his gift of slides and the film, and moved the vote of thanks which was carried with acclamation. J. R. M.

LIVERPOOL AND CHESTER

MERSEY AND NORTH WALES CENTRE

The close of the 1955–56 Session provides a suitable opportunity for the review of the activities of the Mersey and North Wales Centre during the past year.

The winter programme got off to a good start when, at Liverpool on the 3rd October, 1955, the Chairman, Professor J. M. Meek, gave his Address on *Electrical Discharges in Gases.*

A comprehensive programme of papers representing all sections of The Institution's activities were read. Two of the papers were given by local members. Mr. W. Holttum read his paper on *The Installation of Metal-Sheathed Cables on Spaced Supports* at Liverpool on the 9th January, and Mr. E. P. Hill, in collaboration with Mr. A. A. L. Bentall, read a paper on *Control of D.C. Machines* at Chester on the 7th November, 1955. In all, nine papers were read at Liverpool and five at Chester.

In addition to the normal Centre programme a joint meeting with the Liverpool Engineering Society was held at Liverpool on the 7th December, when Mr. E. B. Cole read a paper on *Vibration in Engineering*. The Centre also co-operated with the Liverpool Technical Library in presenting a public lecture on the *Application of Digital Computers* by Dr. T. Kilburn.

The Annual Dinner of the Centre was this year held at the Grosvenor Hotel, Chester, on the 14th November. The function was very successful and was well supported, and the Committee have decided that the Annual Dinner next session will again be held in Chester. The principal guest at the dinner was Mr. P. T. Fletcher of the Industrial Group, U.K.A.E.A., who proposed the toast of 'The Institution of Electrical Engineers'. The reply was given by Sir Hamish MacLaren, a Vice-President. The Rev. L. F. Harvey, in a witty and amusing speech, formally concluded the dinner.

The Annual Dinner-Dance was held at Hulme Hall, Port Sunlight, on the 9th March, 1956, and again proved very popular with members. The duties of Master of Ceremonies were in the capable hands of Mr. T. A. P. Colledge. The Benevolent Fund benefited to the extent of £55 from the sale of floral corsages and raffle tickets.

The Summer Meeting on the 31st May took the form of a coach tour through Shrewsbury to Chirk Castle, where the state rooms and gardens were viewed. The party returned via Llangollen and the Horse Shoe Pass to Chester and Liverpool.

The Golf Tournament was again held on the Southport and Ainsdale Course on the 5th June. S. T.

OXFORD

DISTRICT MEETING

New Tools in Industry—Ultrasonics was the title of an interesting paper read by Mr. E. A. Neppiras to an audience of over sixty at the Southern Electricity Board's offices in Oxford on the 14th March. Mr. J. R. Catlin was in the chair.

The author introduced his subject by giving an outline of the present scope of ultrasonics in industry followed by a description of magnetostriction transducers on which ultra-

sonic tools are based. He proceeded to give instances of recent industrial applications including machining, metal fatigue testing, industrial cleaning and fluid processing. In machining it was explained that ultrasonic vibrations from a resonant magnetostriction transducer are focused by transmission down a resonant tapered metal stub to the drilling tool, which is made to vibrate with oscillatory amplitudes of the order of 0·002–0·005 inch at a frequency of about 20–30 kc/s. A demonstration showed that holes of any shape and pattern can be cut in all brittle materials, including glass, ceramics and brittle metals. Demonstrations were also given in which a resonant magnetostriction transducer was used as the basis of a tool for the accelerated fatigue testing of metals. Mr. Neppiras went on to describe the ultrasonic technique of producing cavitation in liquid media and showed that cavitation easily removes loosely held solid or liquid particles of impurity adhering to a solid surface. The talk was illustrated by lantern slides, and models and examples of work were available for inspection.

After refreshments the many questions answered by the speaker showed the keen interest of members in this new technique. A vote of thanks was proposed by Mr. W. F. Smith, Past-Chairman of the North Midland Centre, who congratulated the speaker on the able manner in which he dealt with the subject. V. B.

SCOTLAND

SCOTTISH CENTRE

In the spring of each year the Scottish Centre becomes involved in a spate of Annual General Meetings. At the meeting of the South-West Scotland Sub-Centre, on the 2nd May in Glasgow, Dr. J. W. Macfarlane was elected Chairman for the next session; after the formal business a welcome breath of sea air was introduced by Commander C. G. Forsberg, who read a paper on *The Recent Search for, and Salvage of, the Comet Aircraft near Elba*, by himself and Mr. G. G. MacNeice. In his remarks at the meeting of the South-East Scotland Sub-Centre in Edinburgh on the 8th May, the Chairman, Mr. W. B. Laing, referred particularly to the enthusiastic support given to the Sub-Centre by members travelling over the water from Fife and also from the Borders. After the formal business, which included the election of Mr. F. G. Bennett as Chairman for the 1956–57 Session, the customary short papers by a senior member and by a member of the Graduate and Student Section were presented. Mr. S. C. Black, GRADUATE, gave an abbreviated version of his paper on *Automatic Production Techniques for Electric Circuitry*, previously read before the Graduate and Student Section. Mr. Black spoke down to a level suitable for the senior members and gave a most interesting account of the printed-circuit technique that was quite new to most of those present; he also dealt very well with the lively discussion that followed. Mr. J. L. Egginton, MEMBER, spoke on *The Calendar* and described in an extremely amusing, but nevertheless most authoritative, manner the development of the calendar, from the early devices of the Egyptians, Babylonians and ancient Britons to the modern almanac that we now take for granted as a normal part of our daily life.

The meeting of the North Scotland Sub-Centre took place in Dundee on the 10th May, when Mr. R. B. Anderson was elected as the next Sub-Centre Chairman. The meeting was followed by a showing of the film *The Inquiring Mind*.

Finally, in Edinburgh on the 22nd May, the Annual General Meeting of the Scottish Centre was held. Dr. E. Wilkinson delivered his Chairman's Address, *Straw for the Bricks*, brief details of which were given in these notes in May.

The Spring Meeting took place at the Atholl Palace Hotel, Pitlochry, from the 18th to 21st May, and once again members and guests, about sixty in all, enjoyed a week-end amongst the incomparable Perthshire hills. Assembly on Friday evening (the 18th) permitted a start to be made at 9 a.m. on Saturday with the Hutcheson-Winning Golf Competition, won this year by Mr. J. Millet. Dr. J. Jamieson, whose name has frequently appeared in these columns as a winner, this year won the bogey competition. Saturday afternoon was devoted to a drive through the delightful scenery around Aberfeldy and Loch Tay, the justification for this most enjoyable excursion being a visit to the Ben Lawers hydro-electric scheme, now nearing completion and in partial operation. Members were welcomed and entertained to tea at the power station by Mr. A. A. Fulton, General Manager of the North of Scotland Hydro-Electric Board. In the evening a visit was paid to the Pitlochry Festival Theatre to see a highly amusing comedy, *The Open*, which effectively punctured any swollen heads achieved by the golfers in the morning. Sunday was devoted to miscellaneous putting and other competitions, and, for the more energetic, to mild explorations of Loch Faskally and the neighbouring hills. Once again the Spring Meeting proved to be one of the most enjoyable and successful events in the calendar of the Scottish Centre. E. O. T.

THE SOUTH COAST

SOUTHERN CENTRE

At the Annual General Meeting of the Centre, held at the Chamber of Commerce, Portsmouth, on the 11th April, 1956, the Chairman, Mr. L. H. Fuller, took the opportunity to review the work of the session. He referred to the difficult problem the Committee had to face arising from the geography of the Centre and the varied character of the membership. This affected the choice of papers, the location of meetings and the nomination of members to serve on the Committee. Great care is necessary to secure a balance in these matters in order that the range of professional interests should be adequately represented.

For the forthcoming session, Mr. H. Robson has been nominated as Chairman-Elect, and Dr. L. G. A. Sims, Mr. G. Bishop and Mr. W. D. Mallinson were nominated as Vice-Chairmen. Two senior Vice-Chairmen, Mr. E. H. Skinner and Mr. E. R. Evans, are retiring from the Committee for business reasons. The Chairman expressed the thanks and appreciation of the Committee to the retiring members for their ready assistance and support throughout the session.

The total membership of the Centre shows a slight increase. The Centre has had fifteen ordinary meetings and thirteen District Meetings, making a total for the session of twenty-eight, of which the Chairman attended twenty-two. He regretted that circumstances had prevented him from attending either of the Southampton meetings. The average attendance at all these meetings was fifty-one. The venues have been: Portsmouth, 8; Brighton and Hove, 5; Southampton, 2; Salisbury, 1; Bournemouth, 1; Farnborough, 5; Weymouth, 6.

The preponderance of Portsmouth meetings is due to the fact that this city is the natural geographical centre of the

A group photographed at the Annual Dinner and Dance of the Southern Centre

Left to right: Mr. and Mrs. C. F. Carr, Mr. and Mrs. L. H. Fuller, and Sir Hamish MacLaren.

area, and it will be noted that the outer points are equally represented with five meetings each. It may be wondered why Southampton has only two, but it should be borne in mind that it is not far from Portsmouth and has two additional functions in the Faraday Lecture and the Annual Dinner and Dance. Joint meetings were held with The Institution of Civil Engineers, The Institution of Mechanical Engineers, and our own Graduate and Student Section, as in previous years. It is proposed to maintain the same general pattern next session.

The Annual Dinner and Dance were again held at Southampton, on the 15th December, 1955; this was the usual very pleasant occasion, with an attendance of 167. The principal guest was Mr. C. F. Carr, the General Manager of a newspaper publishing company. The visiting Vice-President on this occasion was Sir Hamish MacLaren, who assured the Chairman that the function compared very favourably with others elsewhere—which is praise indeed.

When the question of the Faraday Lecture was raised, the Committee thought that the absence of coal mines in the area would not affect the interest shown by the general public, which is maintained year after year, in this series of lectures. The event proved that they were not mistaken, for the lecture was the usual success. But it must not be thought that the Faraday Lecture comes automatically to us every year. There is a definite limit on the number of appearances possible, and in some years we must miss it, as we did last year. The Chairman said that he could give no guarantee that next session we shall again be fortunate,

For the Summer Meeting last session we visited the Hackbridge and Hewittic Company's works at Walton-on-Thames, and Hampton Court Palace, under the chairmanship of Mr. E. A. Logan. The Chairman remarked that this was voted the best Summer Meeting we had ever had.

At the Annual General Meeting the Chairman made two appeals in these terms, 'First, you are all aware of the Benevolent Fund and its aims and objects. During my term of office I have seen some of the tangible results of the help given to deserving and unfortunate members of our profession or their dependants, which is made possible by your generosity, and which can only be kept going by a continuance of that generosity.

'Secondly, may I appeal for papers or lectures by local authors on technical matters of general and practical interest. I am not unaware that the dissemination of new technical knowledge is one of our Institution's objects, but I suspect that I may not be the only one who is getting perhaps a little old to understand much of the startling new developments which are taking place just now, and it would be nice to temper the more technical and specialized aspects with a modicum of matter of more general interest. The Honorary Secretary will be glad to assist with advice on the preparation of papers.'

After the meeting Mr. W. Ford opened a discussion on *Soldered Joints.* E. A. L.

YORKSHIRE

NORTH MIDLAND CENTRE

The Annual Dinner-Dance of the North Midland Centre, which was held at the Cairn Hydro Hotel, Harrogate, on the 23rd March, 1956, was a great success, over 330 people being present. We were delighted to be received by the President, Sir George Nelson, Lady Nelson, our Chairman, Mr. F. Barrell, and Mrs. Barrell, and to see once again the Secretary and Mrs. Brasher. Our Honorary Treasurer of the Benevolent Fund, Mr. J. G. Craven, made his final appeal, before retirement from office, on behalf of the Benevolent and Homes Funds, and the response was a record collection of £130, comprising donations and the results of a prize draw. We are indebted to the many generous donors of prizes and to the wonderful support which we received from our members and their friends. Mr. J. Lawton was the Master of Ceremonies for the dancing, which proved so popular that we decided to go on for an extra half an hour and thereby rounded off the proceedings happily at 1.30 a.m.

At our sixth ordinary meeting at Leeds on the 27th March, the Chairman informed members of the death of a Past-Chairman, Mr. S. R. Siviour. The assembly stood in silence for a moment as a mark of respect to an old and valued friend.

We welcomed two new Corporate Members, and went on to offer our congratulations, together with those of the President, Sir George Nelson, to another Past-Chairman, Mr. E. Lunn, on the completion of 50 years of Corporate Membership of The Institution. Mr. Lunn, whom we were happy to have with us, replied suitably. The Chairman then invited one of our own members, Mr. W. H. Dunkley, to present his lecture entitled *Ends and Means in Power Station Construction.* As with everything that Mr. Dunkley undertakes, this was a thoughtful and stimulating discourse filled with wit and learning. The discussion which followed was opened by Mr. C. G. Richards and supported by several other members, and the applause when our Chairman thanked Mr. Dunkley for this most interesting lecture was loud and long.

J. L.

BUENOS AIRES

ARGENTINA JOINT OVERSEA GROUP

Members of the Argentina Joint Oversea Group combined in a luncheon meeting with the British Engineering Association of the River Plate at the English Club, Buenos Aires, on the 21st May. The guest speaker was Mr. Jorge Cordes, an architect, who talked on his experiences in England, where he studied town planning during the Second World War and afterwards. The lecture was extremely interesting and well worth hearing. About forty members of the two bodies attended the luncheon.

The Group was invited to form a table at the banquet given on the 30th May by the Centro Argentino de Ingenieros in connection with 'Engineering Week' in Argentina. The banquet was honoured by the President and Vice-President of the Argentine Provisional Government. Owing to the hostility of the recent Government the banquet was the first that the Centro Argentino de Ingenieros has been able to hold for twelve years.

It is with regret that we record the death of Mr. Archibald Stanley Cowlishaw, A.M.I.MECH.E., on the 10th May in Buenos Aires. Mr. Cowlishaw came to Argentina in 1925 on contract for the Central Argentine Railway (as it was then called), from which he retired in the early part of 1950. A. C. T.

UNITED STATES OF AMERICA

From the 19th to 21st May, 1956, when the President and Secretary of The Institution were *en route* to the Annual Meeting of the Engineering Institute of Canada at Toronto on the 23rd May, they stopped in New York for an all too brief visit. On Monday, May 21st, Mr. M. D. Hooven, President of the American Institute of Electrical Engineers, gave a luncheon in honour of Sir George, which was attended by Mr. Brasher, many of the Presidents and officers of the national engineering societies, other prominent engineers, close personal friends and business associates of Sir George, and Mr. R. H. Barclay, the Hon. Secretary of The Institution in the United States. After Mr. Hooven had welcomed him and the other guests, Sir George made a brief response on matters of great interest to those present.

The Winter General Meeting of the A.I.E.E. was held at the Statler Hotel in New York City from the 30th January to the 3rd February. This was the largest annual winter gathering in the seventy-two years of the Institute, 5000 members registering from all parts of United States and Canada. During the meeting the Edison Medal was presented to Mr. L. A. Umansky. It will be of interest to The Institution's members to know that the annual prize of the A.I.E.E. Communications Division was awarded for the paper accepted jointly by the A.I.E.E. and The Institution on *A Transatlantic Telephone Cable*, by Dr. M. J. Kelly, Sir Gordon Radley, Mr. G. W. Gilman and Mr. R. J. Halsey, for which the John Hopkinson Premium of The Institution and the international Christopher Columbus Prize have already been awarded.

The 1956 I.R.E. National Convention, held in New York in May, was attended by over 40000 engineers and scientists.

On the 5th March, Dr. William F. Durand, sometimes called the 'Dean of Engineering', celebrated his 97th birthday and the occasion received appropriate notices and complimentary references to his career and achievements in the Press.

A group of consulting engineers from many foreign countries has been visiting many points in the United States to acquaint themselves with practices and standards used here. The tour, sponsored by the International Cooperation Administration, was opened on the 21st May at a meeting in New York, where several American engineers addressed the group on various aspects of engineering practice and on the organization of the profession in the United States.

The Engineers' Council for Professional Development, in co-operation with the Engineers' Joint Council, is about to undertake a 'pilot study' to determine the present and prospective needs for engineering services, the improvement in the utilization of engineers and supporting personnel, the scope and nature of the education and training required, the problems of engineering registration by the several states, and other matters pertinent to a comprehensive field survey which is subsequently to be undertaken. R. H. B.

Pacific Power

The following notes have been received from a member who is now in Malaya.

Last year I had the opportunity of travelling from Kuala Lumpur, Malaya, to San Francisco. I visited several power plants on the way, and, thinking that others might be interested in my impressions, I kept a few notes.

My wife and I made the trip, travelling by air. We left Kuala Lumpur at 8 a.m. on a fine sunny morning. We stopped at Malacca *en route* and finally landed at Kallang Airport, Singapore. Kallang has since been replaced by a vast new airport, on a different site. Coming into Singapore by air, I was impressed chiefly by the huge new housing projects to be seen in every direction. In spite of the severe unrest that has preceded and accompanied the introduction of partial self-government, capital investment in these large schemes of social improvement has continued unabated.

When we were in Singapore three years ago, electric power was rationed. A new generating station has been built since then, but as we had less than twenty-four hours in the city, there was insufficient time to make the necessary arrangements to visit it. It is certain that in Singapore, as elsewhere throughout the world, the generation of electricity is being hard pressed to keep up with the insistent demand for more power.

From Singapore we travelled to Hong Kong, with a stop at Saigon on the way; we had a week in Hong Kong and found it a fascinating city. The shops and restaurants are wonderful and the scenery superb. I visited the North Point station of the Hong Kong Electric Co. The station is erected on reclaimed ground, the foundations consisting of 50–60 ft piles. One of the problems the company was tackling was the misalignment—about ¼ inch—of a 15 MW set, erected on foundations designed for a 10 MW set. The whole foundation was being rebuilt. The station was being actively developed, and a modern oil-fired boiler was under erection, having a capacity of 250000 lb/hour at a pressure of 450 lb. The boiler

has water-cooled walls, the top drum is supported by the tubes, and there is provision for expansion in two directions. Among other modern boilers in the plant are one coal-fired, one oil/coal-fired, and two boilers converted from coal to oil in the company's own shops. There is one further modern oil-fired boiler. The coal used has a high ash content, and this material is re-burned in the oil/coal furnaces.

There are eight sets in the turbine room, including one house set, the largest is rated at 20 MW. The generated voltage is 6·6 kV. The company is in the happy position of having no overhead lines whatever, for the entire distribution system is underground. Ultimately, a new station will be erected adjacent to the present station. Concrete coal bunkers were being cleared for this purpose when I was there.

We left Hong Kong with regret and flew to Tokyo. Tokyo

The Hawaiian Electric Co.'s Bishop Street station, with the modern 'Number Eight' plant in the rear

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gives you the impression of being a poorly lighted city from the air, and this is confirmed when you land. But Haneda airport is wonderful—built in 1955, modern in every respect, and spotlessly clean. Among all the new synthetic materials used, I was pleased to see that the Japanese still use much wood for doors, panels, and furniture.

A few days after our arrival in Tokyo, we set out for Sakuma to see one of the dams being constructed under a five-year plan to increase hydro-electric power, at a total cost of 2250 million dollars. We travelled on the Japanese railways, which are electrified in every direction from Tokyo. They are clean, comfortable and fast, and serve excellent meals. The Japanese make extensive use of public-address systems, all railway carriages, buses, and station platforms being equipped with loudspeakers.

We saw Sakuma dam at night—a spectacular sight—and again the following morning. When finished, it will be the tenth largest dam in the world. What really broke the back of the job was the completion of the twin 40 ft diameter diversion tunnels, which the Japanese engineers estimated would take 1½ years to complete; the Americans, with the experience of the Boulder Dam and other Bureau of Reclamation dams behind them, did the job in 2½ months; 16-drill rail-mounted jumbos were used.

The power station, some distance downstream from the dam, contains four 90 MW units, generating at 11 kV. The voltage is stepped up to 275 kV for transmission to load centres. Japan has the confusion of two frequencies; 50 c/s is standard in the Tokyo area, while 60 c/s is used at Sakuma, farther to the south. The whole of the equipment for this massive station was manufactured in Japan. No expense has been spared on the power-house building. Interior walls on rooms and galleries are beautifully plastered. The main transformers, and associated busbars and switchgear, are all outside.

A day or two after returning to Tokyo, I visited a modern steam plant. This plant will have an initial capacity of two 66 MW units, and an ultimate capacity of six units. Everything again is on a massive scale, and the power-house building has the same beautiful finish as Sakuma. The pulverized-fuel boilers are 100 ft high and include economizers and superheaters. Steam is generated at a pressure of 1250 lb/in². Precipitators are installed between the boilers and stack and are designed for 97% extraction.

We left Tokyo, again with regret, and flew to Honolulu. The surprising thing about this long journey is that you arrive in Honolulu before you leave Tokyo, having crossed the international date-line meanwhile. The journey is broken at Wake Island, a dreary expanse of coral in mid-Pacific.

The first thing we noticed in Honolulu was the beautiful coolness after the heat and humidity of Hong Kong and Tokyo. There was a drop in humidity and the north-east trade-winds were blowing. Honolulu is a major city now, with efficient public services. Transport is by single-decker trolley-buses and Diesel buses, and the equipment is clean, modern, and fast. Public parks are efficiently administered and are scattered all over the island. Signs say: 'These are your parks and beaches. Have fun, but don't abuse the privilege.' The scenery is of course superb. I visited the Honolulu plant of the Hawaiian Electric Company. It consists of two portions; a pre-war plant, extended five times, the latest in 1944, and a modern plant—'Number Eight'—containing one 40 MW hydrogen-cooled set commissioned in December, 1944. This set was taken out of service for inspection in April, 1955. It was then returned to service and is expected to run continuously until April, 1956.

The staff of the new plant has been cut to a minimum and consists of only three men per shift. The boilers are oil-fired and have a capacity of 485 000 lb of steam per hour, at a pressure of 1500 lb/in.² and a total heat of 950° F. The alternator operates at a speed of 3600 r.p.m. The generated voltage is 11 kV, stepped up to 44 kV for transmission purposes. The company at present estimates that one new 40 MW set will have to be commissioned every four years, to keep pace with the expansion of Honolulu. For the benefit of visitors to the plant large signs are erected on all equipment, stating in simple language the function of the part, and its cost, such as: 'This elevator cost $40 000. It is used to carry men and equipment.' Such signs state that the turbine and alternator cost $1 500 000 and the boiler $1 000 000. C. G. R.

OVERSEA ATTENDANCE REGISTER

During the period 1st May to 31st May, 1956, the following members called at the Institution Building and signed the Attendance Register of Oversea Members:

AUGOOD, E. B. (Toronto).
COLLEN, R. D. (Mauritius).
COSGROVE, A. O., B.SC. (Nairobi).
GALLOWAY, J. J. (Lagos).
GRAHAM, M. J., B.SC. (Pretoria).
HORT, E. P. (Kirkuk, Iraq).
KING, J. A. C. (Kuwait).
LANGFIELD, G. F., B.SC.(ENG.) (St. Catherines, Ontario).
MORLEY, E. W. L. (Kuala Lumpur).
NEEDHAM, C. F. (Wellington, New Zealand).
SIMPSON, G. F. (Lagos).
SMUTS, M. N., B.SC.(ENG.) (Worcester, South Africa).
STOCK, J. M., O.B.E., M.ENG. (Kampala, Uganda).
THOMAS, N. E., B.SC.(ENG.) (Kuala Lumpur).
TURNER, H. A., B.SC.(ENG.) (Kuching, Sarawak).
VAN HEYNINGEN, G. P. K. (Durban).
WINTER, D. F. (Robertsfield, Liberia).
WINTER, N. R. (Toronto).

ANNOUNCEMENTS TO MEMBERS

THE HOMES FUND

SUMMARY OF CONTRIBUTIONS RECEIVED TO 25TH JUNE, 1956

	No. of Contributors	£	s.	d.
£1 000 and over	6	6000	0	0
£100 to <£1 000	29	6386	3	0
£5 to <£100	783	8533	6	5
£2 to <£5	1907	5261	2	2
Under £2	19585	10271	3	6
		£36451	15	1

HONOURS AND DISTINCTIONS CONFERRED ON MEMBERS

THE QUEEN'S BIRTHDAY LIST

The names of the following members of The Institution were included in the list of Birthday Honours and Distinctions conferred by Her Majesty:

K.C.B.
Radley, Sir Gordon, C.B.E., PH.D.(ENG.) (*Member*).

C.B.
Anderson, J., C.B.E. (*Member*).
Fryer, Major-General W. G., C.B.E. (*Member*).

C.B.E.
Bedford, L. H., O.B.E., M.A., B.SC.(ENG.) (*Member*).
Owen, J. McA. (*Member*).
Peattie, J. D., B.SC. (*Member*).

O.B.E.
Britton, C. A., M.ENG. (*Member*).
Cormack, J., B.SC. (*Member*).
Golding, E. W., M.SC.TECH. (*Member*).
Heyes, C., B.SC.(ENG.) (*Member*).
Horn, C. O., B.SC. (*Member*).
Howe, A. B., M.SC. (*Associate Member*).
Jofeh, M. L. (*Associate Member*).
Jolley, E. H. (*Member*).
Midgley, Harold, M.SC. (*Member*).

M.B.E.
Aked, J. A. (*Member*).

ELECTION OF COUNCIL FOR THE YEAR 1956–57

The following were nominated for the vacancies which will occur in the offices of President, Vice-Presidents, Honorary Treasurer and Ordinary Members of Council on the 30th September next:

President SIR GORDON RADLEY, K.C.B., C.B.E., PH.D.(ENG.)

Vice-Presidents
S. F. GOODALL, M.SC.(ENG.)
G. S. C. LUCAS, O.B.E.

Honorary Treasurer THE RT. HON. THE VISCOUNT FALMOUTH

Ordinary Members of Council

Members
J. A. BROUGHALL, B.SC.(ENG.)
B. DONKIN, B.A.
A. H. MUMFORD, O.B.E., B.SC.(ENG.)
D. P. SAYERS, B.SC.
H. WATSON-JONES, M.ENG.
H. WEST

Associate Member
E. M. HICKIN

No other nominations having been received the constitution of the Council for next session will be as follows:

President SIR GORDON RADLEY, K.C.B., C.B.E., PH.D.(ENG.)

The Past-Presidents

Vice-Presidents
T. E. GOLDUP, C.B.E.
S. E. GOODALL, M.SC.(ENG.)
WILLIS JACKSON, D.SC., D.PHIL., DR.SC.TECH., F.R.S.
G. S. C. LUCAS, O.B.E.
SIR HAMISH D. MACLAREN, K.B.E., C.B., D.F.C., LL.D., B.SC.

Honorary Treasurer THE RT. HON. THE VISCOUNT FALMOUTH

Ordinary Members of Council

Members
PROFESSOR H. E. M. BARLOW, PH.D., B.SC.(ENG.)
J. A. BROUGHALL, B.SC.(ENG.)
C. M. COCK
A. R. COOPER, M.ENG.
B. DONKIN, B.A.
PROFESSOR J. GREIG, M.SC., PH.D.
F. J. LANE, O.B.E., M.SC.
C. T. MELLING, C.B.E., M.SC.TECH.
H. H. MULLENS, B.SC.
A. H. MUMFORD, O.B.E., B.SC.(ENG.)
W. F. PARKER
D. P. SAYERS, B.SC.
H. WATSON-JONES, M.ENG.
H. WEST
E. L. E. WHEATCROFT, M.A.

Associate Members
E. M. HICKIN
D. MCDONALD, B.SC.
D. B. WELBOURN, M.A.
J. H. WESTCOTT, B.SC.(ENG.), PH.D.

Companion
G. L. WATES, J.P.

Associate
J. BENNETT

Chairmen and Past-Chairmen of Sections
*W. BAMFORD, B.SC. (MEASUREMENT AND CONTROL)
*L. DRUCQUER (SUPPLY)
H. J. GIBSON, B.SC. (UTILIZATION)
*D. B. HOGG, M.B.E., T.D. (UTILIZATION)
P. J. RYLE, B.SC.(ENG.) (SUPPLY)
*H. STANESBY (RADIO AND TELECOMMUNICATION)
D. TAYLOR, M.SC., PH.D. (MEASUREMENT AND CONTROL
R. C. G. WILLIAMS, PH.D., B.SC. (ENG.) (RADIO AND TELECOMMUNICATION)

* Past-Chairmen.

Chairmen and Past-Chairmen of Local Centres
*F. BARRELL (NORTH MIDLAND)
PROFESSOR F. M. BRUCE, M.SC., PH.D. (SCOTTISH)
J. CHRISTIE (NORTH-EASTERN)
*MAJOR E. N. CUNLIFFE, B.SC.TECH. (NORTHERN IRELAND)
T. E. DANIEL, M.ENG. (NORTH-WESTERN)
*T. G. DASH, J.P. (WESTERN)
*H. S. DAVIDSON, T.D. (SOUTH MIDLAND)
W. K. FLEMING (NORTH MIDLAND)
*L. H. FULLER, B.SC.(ENG.) (SOUTHERN)
C. J. O. GARRARD, M.SC. (SOUTH MIDLAND)
H. L. HASLEGRAVE, M.A., PH.D., M.SC.(ENG.) (EAST MIDLAND)
*A. H. KENYON (NORTH-EASTERN)
*PROFESSOR J. M. MEEK, D.ENG. (MERSEY AND NORTH WALES)
D. S. PARRY (NORTHERN IRELAND)
PROFESSOR G. H. RAWCLIFFE, M.A., D.SC. (WESTERN)
*F. R. C. ROBERTS (EAST MIDLAND)
H. ROBSON, B.SC. (SOUTHERN)
*G. V. SADLER (NORTH-WESTERN)
P. D'E. STOWELL, B.SC. (MERSEY AND NORTH WALES)
*E. WILKINSON, PH.D., B.ENG. (SCOTTISH)

* Past-Chairmen.

ELECTION OF SECTION COMMITTEES FOR THE YEAR 1956–57

MEASUREMENT AND CONTROL SECTION

The following were nominated for the vacancies which will occur on the Committee of the Measurement and Control Section on the 30th September next:

Chairman D. TAYLOR, M.SC., PH.D.

Vice-Chairman PROFESSOR C. HOLT SMITH, C.B.E., M.SC.

Ordinary Members of Committee
W. S. ELLIOTT, M.A.
W. C. LISTER, B.SC.
R. S. MEDLOCK, B.SC.
M. V. WILKES, M.A., PH.D.
R. H. TIZARD, B.A.

No other nominations having been received, the constitution of the Committee for next session will be as follows:

Chairman DENIS TAYLOR, M.SC., PH.D.

Vice-Chairmen

H. S. PETCH, B.SC.(ENG.)
PROFESSOR C. HOLT SMITH, C.B.E., M.SC.

Past-Chairmen

W. BAMFORD, B.SC.
M. WHITEHEAD

Ordinary Members of Committee

J. BELL, M.SC.
PROFESSOR F. BRAILSFORD, PH.D., B.SC.(ENG.)
D. EDMUNDSON, B.SC.(ENG.)
W. S. ELLIOTT, M.A.
M. KAUFMANN
W. C. LISTER, B.SC.
R. S. MEDLOCK, B.SC.
C. RYDER
R. H. TIZARD, B.A.
PROFESSOR A. TUSTIN, M.SC.
J. K. WEBB, M.SC.(ENG.), B.SC.TECH.
M. V. WILKES, M.A., PH.D.

Together with the following:

The President
A Representative of the Council
The Chairman of the Papers Committee
A Representative of each Local Measurement Group
A Representative of the National Physical Laboratory

RADIO AND TELECOMMUNICATION SECTION

The following were nominated for the vacancies which will occur on the Committee of the Radio and Telecommunication Section on the 30th September next:

Chairman R. C. G. WILLIAMS, PH.D., B.SC.(ENG.)

Vice-Chairman G. MILLINGTON, M.A., B.SC.

Ordinary Members of Committee

W. J. BRAY, M.SC.(ENG.)
H. A. M. CLARK, B.SC.(ENG.)
C. W. EARP, B.A.
V. J. FRANCIS, B.SC.

No other nominations having been received the constitution of the Committee for next session will be as follows:

Chairman R. C. G. WILLIAMS, PH.D., B.SC.(ENG.)

Vice-Chairmen

J. S. MCPETRIE, PH.D., D.SC.
G. MILLINGTON, M.A., B.SC.

Past-Chairmen

H. STANESBY
C. W. OATLEY, O.B.E., M.A., M.SC.

Ordinary Members of Committee

A. J. BIGGS, PH.D., B.SC.
W. J. BRAY, M.SC.(ENG.)
H. A. M. CLARK, B.SC.(ENG.)
C. W. EARP, B.A.
V. J. FRANCIS, B.SC.
E. V. D. GLAZIER, PH.D.(ENG.), B.SC.
W. ROSS, M.A.
L. RUSHFORTH, M.B.E., B.SC.
T. B. D. TERRONI, B.SC.
A. M. THORNTON, B.SC.
D. R. TURNER, M.ENG.
F. WILLIAMS, B.SC.

Co-opted Member E. H. COOKE-YARBOROUGH

Together with the following:

The President
A Representative of the Council
The Chairman of the Papers Committee
A Representative of each Local Radio and Telecommunication Group
Representatives of the Admiralty, Air Ministry, Department of Scientific and Industrial Research, the Ministry of Supply, the Post Office and the War Office

SUPPLY SECTION

The following were nominated for the vacancies which will occur on the Committee of the Supply Section on the 30th September next:

Chairman P. J. RYLE, B.SC.(ENG.)

Vice-Chairmen

PROFESSOR M. G. SAY, PH.D., M.SC.
J. R. MORTLOCK, PH.D., B.SC.(ENG.)

Ordinary Members of Committee

F. H. S. BROWN, B.SC.
P. M. HOLLINGSWORTH, M.ENG.
J. E. L. ROBINSON, M.SC.
E. P. G. THORNTON
F. C. WALMSLEY

No other nominations having been received, the constitution of the Committee for next session will be as follows:

Chairman P. J. RYLE, B.SC.(ENG.)

Vice-Chairmen

PROFESSOR M. G. SAY, PH.D., M.SC.
D. P. SAYERS, B.SC.
J. R. MORTLOCK, PH.D., B.SC.(ENG.)

Past-Chairmen

L. DRUCQUER
J. D. PEATTIE, B.SC.

Ordinary Members of Committee

H. G. BELL, M.SC.TECH.
J. A. BROUGHALL, B.SC.(ENG.)
F. H. S. BROWN, B.SC.
O. J. CROMPTON, M.ENG.
L. GOSLAND, B.SC.
C. P. HOLDER, B.A.
P. M. HOLLINGSWORTH, M.ENG.
L. C. RICHARDS, B.SC.TECH.
J. E. L. ROBINSON, M.SC.
E. P. G. THORNTON
F. C. WALMSLEY
L. H. WELCH, B.SC.(ENG.)

Together with the following:

The President
A Representative of the Council
The Chairman of the Papers Committee
A Representative of each Local Supply Group

UTILIZATION SECTION

The following were nominated for the vacancies which will occur on the Committee of the Utilization Section on the 30th September next:

Chairman H. J. GIBSON, B.SC.

Vice-Chairman O. W. HUMPHREYS, B.SC.

Ordinary Members of Committee

B. ADKINS, M.A.
H. H. C. BARTON, B.A.
J. B. LANCASTER, B.SC.
P. MCKEARNEY

No other nominations having been received the constitution of the Committee for next session will be as follows:

Chairman H. J. GIBSON, B.SC.

Vice-Chairmen

J. VAUGHAN HARRIES
O. W. HUMPHREYS, B.SC.

Past-Chairmen

D. B. HOGG, M.B.E., T.D.
J. I. BERNARD, B.SC.TECH.

Ordinary Members of Committee

B. ADKINS, M.A.
R. H. M. BARKHAM, B.SC.(ENG.)
H. H. C. BARTON, B.A.
G. H. DAVIDSON
J. M. FERGUSON, B.SC.(ENG.)
T. E. HOUGHTON, M.ENG.
A. J. KING, D.SC., M.SC.TECH.
J. B. LANCASTER, B.SC.
P. MCKEARNEY
A. H. MCQUEEN
R. A. MARRYAT, B.SC.(ENG.)
H. G. TAYLOR, D.SC.(ENG.)

Together with the following:

The President
A Representative of the Council
The Chairman of the Papers Committee
A Representative of each Local Utilization Group
Representatives of the Admiralty, the Air Ministry, the Ministry of Labour and National Service (Factory Department), the Ministry of Works, the Post Office and the War Office

NUCLEAR POWER STATIONS

A COURSE OF LECTURES AT BRISTOL UNIVERSITY

A course of lectures on 'Nuclear Power Stations' will be held weekly on Thursdays from the 4th October, 1956, to the 4th April, 1957, in the Engineering Department of the University of Bristol. Each lecture will be given twice, at 2.30 p.m. and again at 5.30 p.m. on the same day, so that in effect those enrolling can choose between two parallel courses. There is a team of nine lecturers from industry and the Atomic Energy Research Establishment. The course fee is £2 10s.

Full particulars may be obtained from the Department for Adult Education, The University, Bristol, 8 (Telephone No. Bristol 2–4161, Ext. 208).

CONVENTION ON DIGITAL-COMPUTER TECHNIQUES

An order form for the special Supplements to the *Proceedings* containing the addresses, papers and discussions at the

Convention on Digital-Computer Techniques is being enclosed this month to all subscribers to Part B of the *Proceedings*. Any members or others who do not subscribe for this Part may obtain a copy of the order form on application to the Secretary. It is expected that the Supplements (three in number) will be issued at monthly intervals in September, October and November next, the price to members being 10s. each, or £1 7s. 6d. for the complete set, and to non-members £1 each, or £2 15s. for the complete set.

Those who have already ordered copies on the registration form issued in advance of the Convention are not required to take any further action.

APPOINTMENTS AND NOMINATIONS

BRITISH STANDARDS INSTITUTION TECHNICAL COMMITTEE:

Co-ordination of Definitions, Units and Technical Data Committee (USM/1)

The Council have nominated Professor E. Bradshaw, M.B.E., M.SC.TECH., PH.D., MEMBER, to serve as an additional representative on the above Committee.

COMMITTEE ON RADIO EQUIPMENT FOR CIVIL AIRCRAFT

On the nomination of the British Independent Air Transport Association Ltd., the Council have appointed Mr. M. Newman to serve on the above Committee.

WIRING REGULATIONS COMMITTEE

On the nomination of the Central Electricity Authority and Area Boards, the Council have appointed Mr. A. E. J. Whitcher, B.SC.(ENG.), MEMBER, to serve on the above Committee in place of Mr. H. C. Spence, MEMBER.

COMMUNICATIONS FROM OVERSEA MEMBERS

Oversea members are specially invited to submit, for publication in the *Proceedings*, written communications on papers read before The Institution or published in the *Proceedings* without being read. The contributor's country of residence will be indicated. Brief articles or items of news intended for the *Journal* will also be most welcome.

Copies of all papers read before The Institution are sent to each Oversea Representative of the Council for distribution to members likely to be in a position to submit communications.

MEMBERS TRAVELLING TO AND FROM THE UNITED KINGDOM

Members visiting or taking up residence in the areas of any of the Oversea Branches, Oversea Committees or Joint Oversea Groups, which were listed on pages 68 and 69 of the January issue, are invited to apply to the Secretary of The Institution for a letter of introduction to the appropriate Honorary Secretary.

The Secretary will be obliged if members coming home from oversea will inform him of their addresses in this country, even if they do not desire a change of address to be recorded in the Institution register. This will enable him to advise such members of the various meetings, etc., of The Institution and its Local Centres, and, when occasion arises, to put them in touch with other members.

The Secretary will be pleased if those members from oversea who are able to visit the Institution premises will call upon him.

MODEL FORMS OF GENERAL CONDITIONS OF CONTRACT

Two new Model Forms of General Conditions of Contract have been prepared by a Joint Committee of The Institutions of Mechanical, and of Electrical, Engineers, and published under the authority of the Councils of the two Institutions with effect from the 1st July, 1956. They are:

Model Form B.1: 'Export Contracts with delivery f.o.b. or c.i.f.'
Model Form C: 'Electrical and Mechanical Goods, other than electric cables (Home—Without Erection)'

Model Form B.1 is the second in the series of Model Forms for Export Contracts to be recommended by the two Institutions and the Association of Consulting Engineers (Model Form B.3: 'Export Contracts including delivery to and erection on site' was published in May, 1954). The new Form B.1 supersedes the existing Electrical Model Form B.1 issued in 1928 by The Institution of Electrical Engineers.

The attention of users of these Model Forms is drawn to the fact that because of the constant process of revision by the Committee, it cannot be assumed that, in a given series (e.g. the B Export Series) of Model Forms, the various Forms will differ only in respect of the type of contract, and that standard clauses (e.g. the Arbitration Clause) will necessarily remain the same throughout the series.

The prices of the new Forms (including postage) are: Model Form B.1, 4s. 6d.; Model Form C, 2s. 6d.

VACANCY ON THE STAFF OF *SCIENCE ABSTRACTS*

Applications are invited for a vacancy on the staff of *Science Abstracts* for the editing of *Section B Electrical Engineering*. The duties will consist of a selection of articles from the world's literature, allocation to specialist abstractors, editing the abstracts for publication, and preparation of the subject index.

Applicants should have an engineering or science degree or a corresponding qualification, and some knowledge of most branches of electrical engineering. Experience of a research or design department, or of information work connected with such, is desirable. Familiarity with the literature of electrical engineering, and a wide interest in current developments, are essential, together with a capacity for concise expression and orderly arrangement. Acquaintance with foreign languages is essential, for a large part of the work will involve examination of foreign publications.

The starting salary will depend on age, qualifications and experience. Entry to a superannuation scheme would follow a short period of service. Those who are interested should write to the Secretary, The Institution of Electrical Engineers, Savoy Place, London, W.C.2, giving full particulars of their education, training and experience.

INTERNATIONAL SYMPOSIUM ON RADIO WAVE PROPAGATION

In the announcement about the International Symposium on 'Current Problems in the Propagation of Radio Waves', to be held in Paris in September this year, which was printed on page 311 of the May *Journal*, heading (*b*) was shown incorrectly. This should read: 'Influence of the ground on the radiation and propagation of waves'.

Contents of the Current Issues of the *Proceedings*

PART A. POWER ENGINEERING (JUNE 1956)

See *Journal*, June 1956, page 364.

PART C. MONOGRAPHS (MARCH 19

See *Journal*, March 1956, page 206.

PART B. RADIO AND ELECTRONIC ENGINEERING (JULY 1956)

DATE OF JOURNAL REVIEW OR SPECIAL ARTICLE	
July 1956	L. HARTSHORN, D.SC., AND J. J. DENTON, B.SC. **The Calibration of Inductance Standards at Radio Frequencies** (PAPER No. 2080 M)
July 1956	A. H. M. ARNOLD, PH.D., D.ENG. **Nickel–Chromium–Aluminium–Copper Resistance Wire** (PAPER No. 2084 M)
	Written discussion on **An Extended Analysis of Echo Distortion in the F.M. Transmission of Frequency Division Multiplex**
July 1956	J. F. COALES, O.B.E., M.A., AND A. R. M. NOTON, B.SC. **An On–Off Servo Mechanism with Predicted Change-over** (PAPER No. 1895 M, AUGUST 1955)
May 1956	J. C. WEST, PH.D., J. L. DOUCE, PH.D., AND R. K. LIVESLEY, PH.D. **The Dual-Input Describing Function and its use in the Analysis of Non-Linear Feedback Systems** (PAPER No. 1877 M, JULY 1955)
	Discussion on **Artificial Reverberation** before the North-Eastern Radio and Measurements Group
July 1956	M. V. CALLENDAR, M.A. **The Effect upon Pulse Response of Delay Variation at Low and Middle Frequencies** (PAPER No. 2098 R)
July 1956	H. N. COATES, PH.D., B.SC.(ENG.) **An Electronic Machine for Statistical Particle Analysis** (PAPER No. 2053 M)
July 1956	W. W. H. CLARKE, PH.D., B.SC., W. M. SEARLE, M.SC., AND F. T. VAIL, B.SC. **A Ferrite Microwave Modulator Employing Feedback** (PAPER No. 2061 R)
July 1956	R. I. SKINNER, B.E. **Wide-Band Noise Sources using Cylindrical Gas-Discharge Tubes in Two-Conductor Lines** (PAPER No. 2060 R)
Not yet reviewed	E. FRANKLIN, PH.D., AND J. M. JAMES **The Application of Transistors to the Trigger, Ratemeter and Power-Supply Circuits of Radiation Monitors** (PAPER No. 2049 M, MARCH 1956)
Not yet reviewed	G. B. B. CHAPLIN, M.SC., PH.D. **A Point-Contact Transistor Scaling Circuit with 0·4 Microsec Resolution** (PAPER No. 2064 R, MARCH 1956)
Not yet reviewed	G. B. B. CHAPLIN, M.SC., PH.D., AND A. R. OWENS, M.SC. **A Junction-Transistor Scaling Circuit with 2 Microsec Resolution** (PAPER No. 2076 R, MARCH 1956)
May 1956	D. N. KEEP, B.SC.(ENG.) **Frequency-Modulation Radar for Use in the Mercantile Marine** (PAPER No. 1940 R, NOVEMBER 1955)
July 1956	B. G. PRESSEY, M.SC.(ENG.), PH.D., G. E. ASHWELL, B.SC., AND C. S. FOWLER **Change of Phase with Distance of a Low-Frequency Ground Wave Propagated across a Coast-Line** (PAPER No. 2082 R)
July 1956	B. G. PRESSEY, M.SC.(ENG.), PH.D., AND G. E. ASHWELL, B.SC. **The Deviation of Low-Frequency Ground Waves at a Coast-Line** (PAPER No. 2083 R)
July 1956	C. M. SRIVASTAVA, M.SC. **The Propagation of a Radio Atmospheric** (PAPER No. 2099 R)
Not yet reviewed	G. McK. ALLCOCK, M.SC. **The Prediction of Maximum Usable Frequencies for Radiocommunication over a Transequatorial Path** (PAPER No. 2059 R)
Not yet reviewed	A. M. HUMBY AND C. M. MINNIS, M.SC. **Asymmetry in the Performance of High-Frequency Radiotelegraph Circuits** (PAPER No. 2118 R)
	Discussion on **High-Speed Electronic Analogue Computing Techniques** before the Mersey and North Wales Centre and the South-East Scotland Sub-Centre
Not yet reviewed	W. C. BAIN, M.A., B.SC., PH.D. **Fluctuations in Continuous-Wave Radio Bearings at High Frequencies** (PAPER No. 2124 R)

NAME THIS MEMBER

Last autumn a correction to the monthly Elections and Transfers list (an important but hardly lively feature of the *Journal*) unexpectedly found its way into *Picture Post*. Now 'Elections and Transfers' produces something more surprising—something that could hardly fail to be noted in The Institution *Wisden*, did such a publication exist. In this month's list of Transfers from Graduate to Associate Member, there appear two distinct members with identical Christian names and surnames. No prize is offered to anyone whose philological and statistical skill allows him to predict correctly when this will happen again; but we may surely congratulate these two homonymous Associate Members and wish them good luck in attaining full Membership in the course of time—and on the same date.